Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXII. APRIL, 1922 No. 4

CONTENTS

MOTOR TRUCK SECTION

Use of Motor Vehicles by New Jersey State Highway Department 17
Motor Trucks Operate on Rails in City and Interurban Passenger Service 18
One New York Township Will Light 100 Miles of Highways 22

EDITORIALS 119 120

LEADING ARTICLES

Control of Asphaltic Concrete Mixes 121
The Effect of Soil Moisture on Highway Design 122
Constructing the Turkey Creek Sewer in Kansas City, Missouri 125
Suburban Planning 128
Municipal Sanitary Precautions During Epidemic of Influenza 130
Types and Costs of Pavements Suitable for Texas Cities 132
Making Irrigation Bonds Saleable 135
Refuse Disposal by Incineration in Institutional and Industrial Buildings 137
Solving a Typical Road Problem in the Swamp Lands of Arkansas 140

WATER WORKS SECTION

Methods and Costs of Building 10 Million Gallon, Reinforced Concrete Reservoir for the Indianapolis Water Company 141
Discussion of the Centralized Softening of a Public Water Supply 145
Experience in Centralized Water Softening in McKeesport, Pa., Muskogee, Okla., and Georgetown, Ky. 147
Fire Services as it Relates to Water Supply 148
The Abuse of Sanitary Sewer Systems 154
Experience with the City Manager Plan 155

CONSTRUCTION NEWS AND EQUIPMENT SECTION

Further Simplification of Paving Brick Varieties 25
The Lakewood Float-Bridge 25
Dumorite Reduces Blasting Costs 26
Iowa Procedure in Gravel Road Construction 26

Price: Single copy 25 cents. Annual subscription in U. S. $2.00; Canada, $2.40; Foreign, $2.75.

MUNICIPAL AND COUNTY ENGINEERING is published monthly by Engineering Publishing Company, 702 Wulsin Building, INDIANAPOLIS, INDIANA, A. P. Fox, President, J. H. Pritchard, Secretary.

Changes of address, subscriptions and remittances should be addressed to MUNICIPAL AND COUNTY ENGINEERING, Indianapolis, Indiana. Editorial and business communications should also be addressed to 702 Wulsin Bldg., Indianapolis, Ind.

Editorial and Advertising Offices also at 702 Wulsin Bldg., Indianapolis, Ind. Samuel C. Hadden, Editor and General Manager.

To the Men who do Big Buying

Would you like to receive, free of charge, a copy of the 1922 completely revised edition of MacRae's Blue Book—19,000 classifications, 35,000 names and addresses of manufacturers; weight, ten pounds. We have a limited number that we will put out on this basis. MacRae's Blue Book is used by the purchasing departments and departments of public works of the principal American cities and states. It is also used by America's leading contractors.

To insure receiving a copy of our new edition, simply clip and mail the attached coupon.

Date _____

MacRAE'S BLUE BOOK COMPANY
18 EAST HURON STREET
CHICAGO

You may send me a copy of the current edition of MacRae's Blue Book; express charges collect, and continue this arrangement from year to year until otherwise ordered. It is understood that the only obligation we assume is to give MacRae's Blue Book credit when writing firms listed therein.

Name _____ *Title* _____

Company's Name _____

Street Address _____

City _____ *State* _____

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

1/3 more per dollar

THE DU PONT COMPANY leads the way in the production of more efficient and more economical explosives. In Dumorite, its latest achievement, it has made possible

a great step in the reduction of explosive costs

Dumorite is a new money-saving dynamite which gives you over ⅓ more work for your dollar—a guncotton-nitroglycerin dynamite without a headache—a non-freezing dynamite which can be used successfully at any temperature.

Dumorite has approximately the same strength as 40% dynamite and does the same work, stick for stick. And you can buy 135 to 140 sticks of Dumorite at the same price as 100 sticks of 40%.

Ask the Du Pont Explosives Service Department through our nearest branch office how Dumorite can be used in your work. Ask that question in a letter outlining your requirements. Find out how this new development in explosives manufacture can cut your blasting costs for 1922.

Branch Offices:
Birmingham, Ala.
Boston, Mass.
Buffalo, N. Y.
Chicago, Ill.
Denver, Colo.
Duluth, Minn.
Huntington, W Va.
Kansas City, Mo.
New York, N. Y.
Pittsburgh, Pa.
Portland, Ore.
St. Louis, Mo.
San Francisco, Calif.
Scranton, Pa.
Seattle, Wash.
Spokane, Wash.
Springfield, Ill.

Du Pont Products Exhibit
Atlantic City, N. J.

E. I. du Pont de Nemours & Co., Inc.
Explosives Department, **Sales Division**
Wilmington, Delaware

NON-HEADACHE DU PONT NON-FREEZING

DUMORITE

Heltzel Steel Forms

(FOR SIDEWALKS)

A RAIL—A PEDESTAL—A STAKE—

THAT'S ALL

It is a well-known fact you can set **Heltzel Steel Sidewalk Forms** faster and strip from the finished work quicker than any other.

The division plate can be removed any time without disturbing the side rails.

Write us today for introductory offer before buying. You'll save money.

The Heltzel Steel Form & Iron Co.

MFRS. STEEL FORMS FOR ROADS, CURBS, STREET CURB AND GUTTER, ETC.

WARREN, OHIO

INDIANAPOLIS AND

TEXACO SHEET ASPHALT pavement on Ohio Street, Indianapolis, Ind.

WANTED—A CITY

A city to handle the tremendous output of rich coal lands, oil fields, mineral deposits, and a bountiful agricultural region.

Such a city was wanted—needed — by the Middle West two or so decades ago.

And Indianapolis responded; it "filled the bill" in a masterful manner.

TEXACO SHEET ASPHALT pavement on Massachusetts Ave., Indianapolis, Ind.

As Indianapolis has grown in size and importance, it has exercised wisdom in providing for itself that essential necessity of all modern cities—good pavements.

Like other great cities, Indianapolis has learned that TEXACO ASPHALT pavements are durable, resilient and attractive.

Why don't you write and learn more about TEXACO pavements.

TEXACO

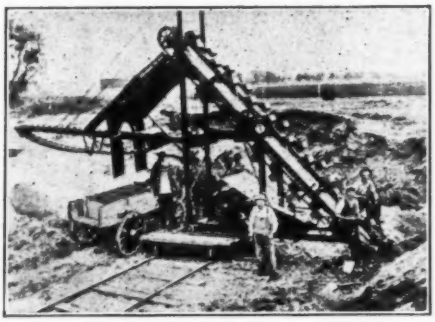
The Texas Company

Asphalt Sales Dept., 17 Battery Place, New York City

New York Houston Richmond Philadelphia Jacksonville Boston New Orleans Atlanta Chicago Memphis Oklahoma City Cleveland [Minneapolis Kansas City Wichita Des Moines

The Michigan Jr. Gravel Screener and Loader

Takes Gravel out of Pit or Pile, Screens out Sand and Stones and Loads the Gravel into Wagons or Trucks.



Several Counties have Purchased Eight or Nine Machines

AGENTS WANTED

The Michigan Jr. holds the low record of cost of handling screened gravel from pit to wagon or truck. This is the all-important consideration, Mr. Contractor. This saving is your profit.

Machine runs up and down side of pit or pile on a track and takes off slice of about ***four*** ft. each time. After going along track once, track is moved over and loader returned along side of pit or pile.

The Screener and Loader is self-contained, furnishing own power, and has attachment on screen that prevents clogging with clay, clods, etc.

Machine has elevating capacity of ***one yard per minute,*** and the only operating expense is salary of three men, under ordinary conditions. One operates machine and two break down embankment.

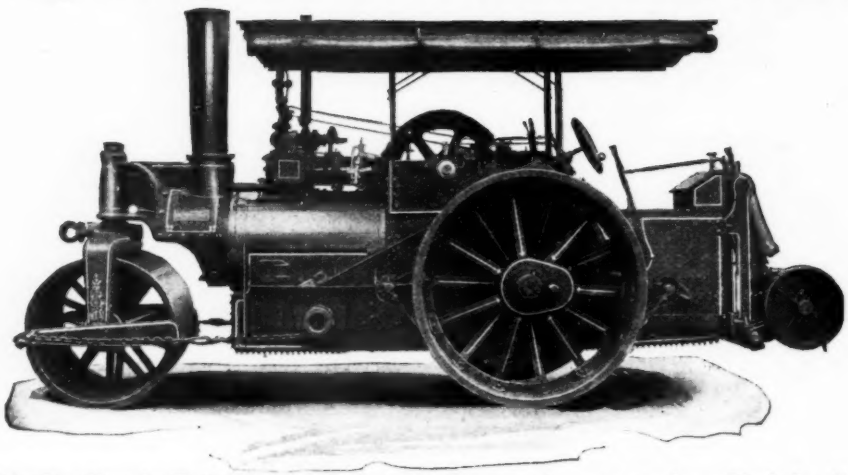
Sand and stone are conveyed 20 ft. away and do not have to be moved. Machine moves under own power. Easily moved from one pit to another. It is all steel, engine enclosed. ***Saves $30 to $50 a day*** in expenses and makes money in handling gravel.

For further particulars write to

THE JORDAN & STEELE MFG. CO., Inc.

CHARLOTTE, MICHIGAN

QUALITY ROLLERS



"Buffalo-Pitts" and **"Kelly-Springfield"** render best and longest service. Made in all types and sizes—steam and motor. Buffalo-Springfield Pressure Scarifiers are money-savers and can be furnished with new rollers or attached in the field to rollers already in use.

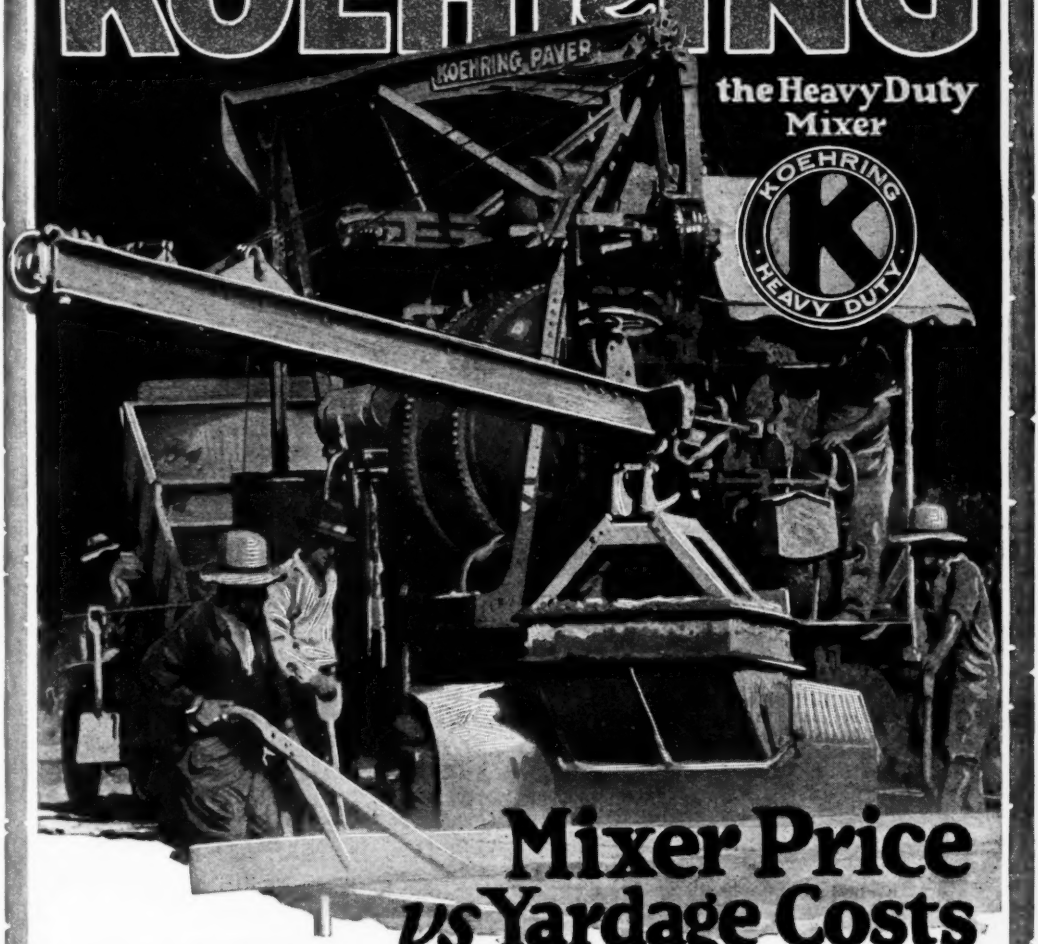
INQUIRIES INVITED

THE BUFFALO-SPRINGFIELD ROLLER COMPANY

SPRINGFIELD, OHIO

KOEHRING

the Heavy Duty Mixer



Mixer Price *vs* Yardage Costs

Two vastly different things!

What's the value of price saving if you fail to get the heavy duty construction which means continuous, uninterrupted performance — lowest cost yardage?

On the job, not on the sales floor, is where your mixer demonstrates its profit and loss worth—and no margin of price can ever compensate for the higher cost of yardage, the loss of breakdowns, delays and fast depreciation.

Mixer heavy duty construction is too vital to your profit to be trifled with, either by you to save a few dollars in purchase price, or by the Koehring company to meet price competition which is always the penalty of quality leadership.

KOEHRING CAPACITIES

Pavers: 7, 14, 21, 32 cu. ft. mixed concrete, steam and gasoline, multi-plane traction, loading derricks, power discharge chute. Write for catalog P 10.

Construction Mixers: 10, 14, 21, 28 cu. ft. mixed concrete, steam and gasoline, power charging skip, batch hoppers. Write for catalog C 10.

Dandie Mixers: 4 and 7 cu. ft. mixed concrete, steam or gasoline, low charging platform, power charging skip, and light duty hoist. Write for catalog D 10.

KOEHRING COMPANY, MILWAUKEE, WIS.

SPECIFY STANDARD VITRIFIED PAVING BRICK.

THE FIRST INDUSTRY TO STANDARDIZE.

TAXPAYERS' VALUE BRICK ROADS

THE FIRST INDUSTRY TO STANDARDIZE.

Preference Given Asphalt Filler for Brick Pavements

The National Paving Brick Manufacturers Association has officially declared its preference for asphalt-filled brick wearing-surfaces for streets and highways *without prejudice to any other type of filler which may be specially adaptable to local conditions.*

The Resolution is as follows:

Whereas: The National Paving Brick Manufacturers Association through its contact with the requirements of the paving market, maintained through the members and field engineers of its Territorial Associations, is increasingly conscious of the trend in engineering design and construction toward asphalt filler, and:

Whereas: Recent investigation discloses that approximately sixty percent of all brick pavements laid in 1921 were so filled, and:

Whereas: The Association interprets this increased proportion of asphalt-filled brick pavements as indication that the majority of engineers and public officials, using vitrified brick for paving, believe that the use of such filler, under specifications providing quality and method of using according or equal to those of the National Paving Brick Manufacturers Association, is calculated generally to insure the construction of brick pavements equal in endurance and economy to the endurance and economy inherent to the individual brick as manufactured, and:

Whereas: It is the traditional policy of this Association publicly to declare its judgment, from time to time, in respect to purposes which it regards as encouraging the wisest use of public funds for paving purposes, therefore:

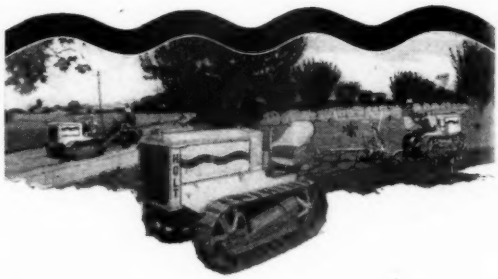
BE IT RESOLVED: That the National Paving Brick Manufacturers Association, assembled in annual conference at Pittsburgh, Pennsylvania, on December 7, 1921, hereby expresses its confidence in asphalt-filled brick wearing-surfaces for street and highway paving properly designed and built with acceptable materials and thorough methods. And that this Association hereby declares its preference for the asphalt-filled types of wearing surface—

PROVIDED: Preferment of the foregoing type of brick wearing-surface for general use shall be without prejudice to any other type which may possess peculiar adaption to special local conditions.

The burned-in service value of vitrified Paving Brick is matched by the aggressive Public Service spirit of the Paving Brick industry.

Natl. *PAVING BRICK* Mfrs. Assn.
804 Engineers Building Cleveland, Ohio

Eastern Paving Brick Manufacturers Association, Lincoln Building, Philadelphia, Pa.
Indiana Paving Brick Manufacturers Association, Fidelity Trust Bldg., Indianapolis, Ind.
Illinois Paving Brick Manufacturers Association, Chamber of Commerce, Chicago, Ill.
Ohio Paving Brick Manufacturers Association, Hartman Building, Columbus, Ohio
Southern Clay Manufacturing Company, Volunteer Building, Chattanooga, Tenn.



For the Lighter Jobs

In the "Caterpillar"* T-35, Holt provides the highway engineer or road contractor with a small compact tractor embodying the same dependable qualities found in the larger "Caterpillars."* The T-35 fits in with the road making and road maintenance programs of every city, town, county and township. Its range of speeds, short-turning and ability to operate in any weather or soil, gives it pronounced advantages over teams or other methods of road dragging and patrol maintenance. It has proved itself indispensable for handling the lighter jobs quickly and economically. We will gladly arrange to show you motion pictures of "Caterpillars"* in action or send you a copy of our new booklet "Caterpillar" Performance.

THE HOLT MFG. COMPANY, *Inc.*
PEORIA, ILLINOIS

Branches and service stations all over the world

Eastern Division: 50 Church St., New York
2429 Farnam St., Omaha, Neb.
417 Washington Ave., N., Minneapolis, Minn.
Merchants Bank Bldg., Indianapolis, Ind.
5th and Court Sts., Des Moines, Iowa.
2045 Main St., Kansas City, Mo.
Holt Company of Texas, Dallas, Texas.
Canadian Holt Co., Ltd., Montreal, P. Q.

CATERPILLAR Reg. U.S. Pat. Off.

HOLT
PEORIA, ILL.
STOCKTON, CALIF.

* *There is but one "CATERPILLAR"—Holt builds it*

Elastite "Sandwich" Construction

Elastite is a body of specially tempered asphaltic compound, inseparably bonded between two walls of asphalt saturated felt. The asphaltic compound in Elastite possesses a high degree of compressibility within its own volume. It permits safe expansion of concrete slabs and maintains perfect joint closure during the most extreme contraction.

Carey Elastite

NAME REG. U.S. Pat. Office

PROVED AND ACCEPTED EXPANSION JOINT

Elastite does not shrink, "dry out," or lose its live elasticity with age or service

ELASTITE Expansion Joint never becomes "old stock." It does not deteriorate either in storage or through exposure.

Extremes of temperature do not affect its complete serviceability. It does not stick together in shipping crates. It does not soften or run in warm temperatures or crack and break in cold weather. It does not twist out of shape, nor does it warp or buckle when the concrete is poured. Elastite construction produces an expansion joint which can be handled as easily as a board.

Installing Elastite completely is an easier, quicker job than setting spacing-boards, only a single preparatory step in making a "poured joint" of any type. Elastite saves time, labor and expense, and never needs "repouring" or repairing.

Elastite is the proved, accepted expansion joint for brick, concrete, granite and wood-block paving, cement sidewalks, and all concrete construction of large area.

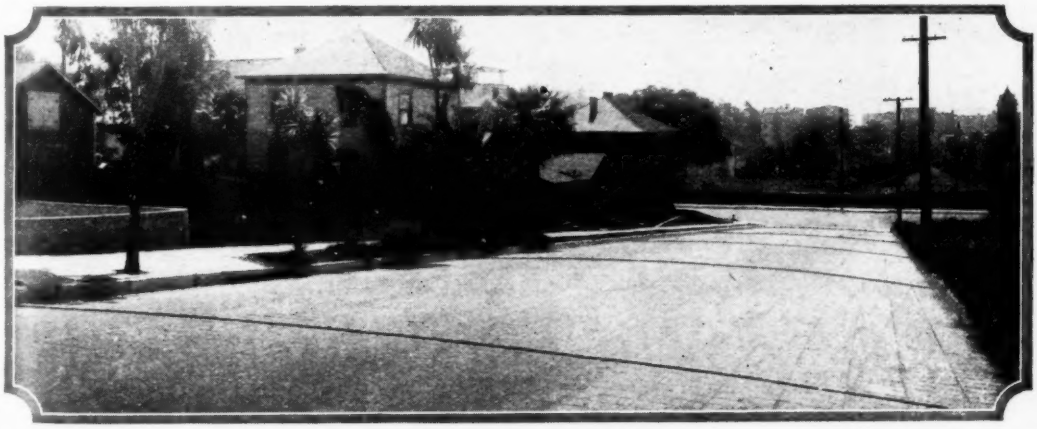
Write for full particulars 2-22

THE PHILIP CAREY COMPANY,
40 Wayne Ave. Cincinnati, Ohio

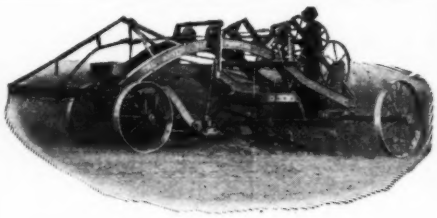
Elastite *is used in these highways and structures*

Dixie Highway
Lincoln Highway
New York State Highways
Pennsylvania State Highways
New Jersey State Highways
Texas State Highways
California State Highways
Washington State Highways
Wayne County, Michigan
Washington County, Miss.
Eden Park Viaduct Cincinnati, Ohio
Yale Bowl, New Haven, Conn.
Jefferson Avenue Viaduct St. Louis, Missouri
Galveston Causeway Galveston, Texas
U. S. Shipping Board Concrete Ships
U. S. Marine Barracks Honolulu

Elastite is made in widths, lengths and thicknesses as required, can be cut to crown or in any special shape and comes to the job ready to use



West Fifth street, Los Angeles, Cal.



A-W Graders
AND
GRADER-SCARIFIERS

14 Models

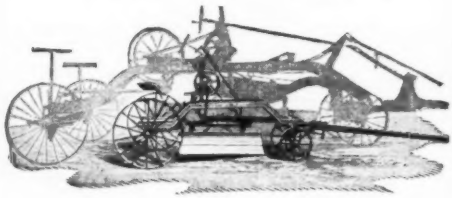
You don't have to look further than the first twenty-one pages of General Catalog No. 21-O to find the machine exactly suited to your needs.

The graders range in weight from the Midget at 1,000 pounds to the No. 20 at 9,000 pounds.

Scarifiers can be attached to all graders of at least standard size, but for a really efficient outfit, choose the Austin Rip Snorter, which scarifies and grades at the same time; or the Western Scarifier, big brother to a grader on the hardest jobs.

It will pay you to read the whole story of Austin-Western Graders.

Send for Catalog No. 21-O.



The Austin-Western Road Machinery Co.

CHICAGO, ILL.

Branches in 22 Cities

EXPORT DEPARTMENT
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

"Everything from a Drag Scraper to a Drag Roller"

PIONEER Highest Quality ASPHALTS

Filler Asphalt

The ideal brick pavement filler. Made to meet the strictest specifications. Low prices and immediate delivery on any quantity.

"PIONEER"

Every monolithic pavement should have an Expansion Joint. **"Pioneer"** is made from an absolutely pure asphalt, giving maximum expansion and contraction efficiency.

Expansion Joint

THE PIONEER ASPHALT CO.

LAWRENCEVILLE, ILL.

Concrete Roads must be reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's
Concrete Reinforcement

Fulfills every engineering requirement.

Send for our book on road building.

CHICAGO
NEW YORK
CLEVELAND
PITTSBURGH
DENVER

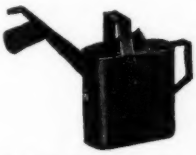
Built Better *for* Better Service

LITTLEFORD
Tar and Asphalt Heaters
FOR ROAD AND STREET WORK

PAVING TOOLS

ASPHALT POTS

Pouring Pot No. 85



Brick Filling Pot No. 86

Carrying Pot No. 87

STYLE No. 48

RIGHT FROM THE START, the basic idea behind the LITTLEFORD TAR AND ASPHALT HEATERS has been **service in the hands of the users.**

Proper design and construction assures you of efficiency and exceptional durability. The gauge of steel used is unusually heavy.

Littleford heaters are made in many styles and different capacities to suit individual requirements. We will gladly send descriptive literature to those interested in road and street construction or maintenance. Write now—a post card will do.

LITTLEFORD BROS.

460 E. Pearl Street **CINCINNATI, OHIO**

IF IT'S HEATERS YOU WANT— WE HAVE THEM—ALL SIZES

This is an ideal type of construction for city or town use for several reasons. Usually storm water runs lazily through a town drain pipe because there is not the fall that it is possible to get on a county road. Hence the problem of keeping these drain pipes open is a big one. A 15″ pipe is only about 8″ high, but spreads out right at the bottom to 15″. This allows a full capacity flow right at the start and the smooth flat bottom made of heavy Galvanized sheets doesn't retard the flow of water. Furthermore, the bottom sections are made in 6-foot, 8-foot and 10-foot lengths, which by using separately or combining you can get the short 6-foot length for drainage under sidewalks and any longer length desired in multiples of 2 feet. All top sections come in 2-foot lengths, which is not only a convenient size for handling, but simple to put in or take up whenever necessary. They ship closely nested and take up no space worth mentioning when in storage. Last but not least they are made of 2-ounce spelter-coated "GENUINE OPEN HEARTH IRON" guaranteed 99.875% pure Iron-Copper Alloy.

The Newport Culvert Co., Inc.
425 W. 10th St, Newport, Ky.

A 15-inch Half Round Flat Bottom **"Genuine Open Hearth Iron"** Culvert.

Most Economical in the Long Run

ASPHALT

for Street and Road Paving

Resilient Noiseless
Resistant Dustless
Waterproof Wearproof

ASPHALT
Makes Tremendous Gains

More than 70,000,000 square yards of asphalt pavement were laid in the United States and Canada in 1921.

The Biggest Year in Asphalt History

Write for Brochures and Complete Specifications on all Asphalt Types

The Asphalt Association
25 W. 43rd St. New York City

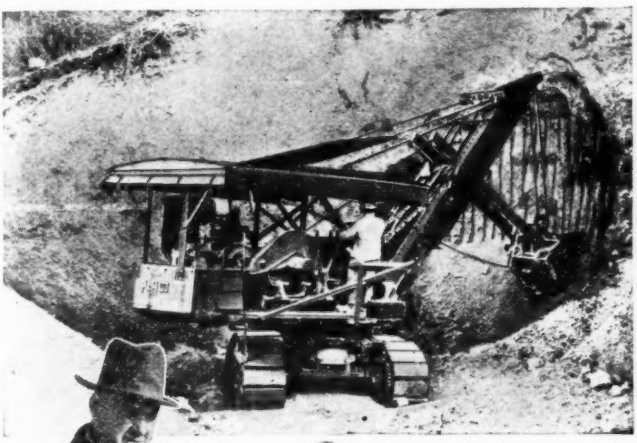
Atlanta, Ga. Chicago, Ill. Albany, N. Y.
Raleigh, N. C. Newark, N. J.

A *service*—not a truck. That's the way to think of a Pierce-Arrow. A means of transportation so sure, so dependable, so unfailingly reliable, that its performance need never be questioned or discounted.

Pierce-Arrow
TRUCKS

The Pierce-Arrow Motor Car Co.
Buffalo, New York

2-ton $3200 3½-ton $4350 5-ton $4850 equipped



ONE MAN operates the P & H

The Shovel with the real crowding motion

To start it ***one man*** simply cranks the motor. Nobody's time nor any fuel is used until the moment the shovel is put in operation.

To excavate, to swing the boom, to maneuver the shovel to another location or shift its position, is also the work of just ***one man.*** All control is centralized.

The total force of the 50 h.p. motor (on the 206 machine) is at all times available for each of the shovel movements crowding, hoisting, swinging and traveling. Being able to throw all its power behind each movement when so required, is the reason for its phenomenal capacity for heavy work.

In city or town, out on the desert, or in a remote mountain location, the P & H Gas Shovel (the pioneer successful machine of this type) is equally efficient and economical.

Just as the gasoline motor truck has proven its power and adaptability, so also has the P & H Gas Shovel done so. Contractors and engineers have learned by actual experience more than we could have told them. They are all in operation from coast to coast.

The P & H Corduroy Gas Shovel:

- ***One-Man Operated.***
- ***No Fireman Required.***
- ***Uses 15 to 18 gals. of gasoline and 1 qt. oil in 8 hours.***
- ***No bother with Coal or Water.***
- ***No Boiler Troubles.***
- ***Starts Immediately.***
- ***Easy Mobility—Full Corduroy Traction.***
- ***The One Gas Shovel with a Real Crowding Motion.***
- ***Wide Adaptability.***
- ***Rugged All-Steel Construction.***

Use a P & H Gas Shovel

EXCAVATING MACHINERY DIVISION

PAWLING & HARNISCHFEGER CO.

Established In 1884

3844 National Ave., Milwaukee, Wis.

New York, Pittsburgh, Salt Lake City, Los Angeles, Chicago, Philadelphia, Denver, San Fransisco, Portland, Seattle, St. Louis, Birmingham, New Orleans, Phoenix

P&H GAS SHOVEL

THE CUMMER ROAD ASPHALT PLANT

THREE SIZES THREE UNITS

Capacity 750, 1250 and 1800 Square Yards 2-inch Top or Macadam Daily

THE CUMMER ONE-CAR ASPHALT PLANT

Capacity 2000 Square Yards 2-inch Top or Macadam Daily

THE F. D. CUMMER & SON COMPANY

CLEVELAND, OHIO. New York Office, 19 West 44th Street.

Selling Agents British Isles
MILLARS' TIMBER & TRADING COMPANY, Limited
London, E. C. 2
Full line Cummer Plants in London stock

WM. E. DEE CLAY MFG. CO.

Proprietors of MECCA CLAY WORKS

Manufacturers of

STANDARD AND DOUBLE STRENGTH

Sewer Pipe, Drain Tile, Culvert Pipe, Well Tubing, Flue Lining, Wall Coping and Fire Brick.

WORKS { Mecca, Parke County, Ind., on C. & E. I. R. R.
Newport, Vermillion County, Ind., on C. & E. I. R. R.

Chicago Office,
30 N. LaSalle Street.

SPRINGFIELD PAVING BRICK

ARE WIDELY USED

Springfield Paving Brick Company

SPRINGFIELD, ILLINOIS.

No tar adulterant in this oil—that's why wood blocks treated with it won't bulge or bleed

REILLY'S IMPROVED PERMANENT CREOSOTE OIL

REPUBLIC CREOSOTING COMPANY, Indianapolis, Ind.
Plants: Indianapolis Minneapolis Mobile Seattle Norfolk

Accuracy at Less Cost

Replace men spreading stone, slag or gravel on roadbeds with the cheaper and more accurate

BURCH SPREADER

You will save its cost in a mile, save time, reduce the cost of supervision and carry out the contract more profitably and quicker.

Let us send you a circular to prove what we say

THE BURCH PLOW WORKS CO.

143 Bucyrus St. CRESTLINE, OHIO

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

Motor Truck Operation and Accounting—80

USE OF MOTOR VEHICLES BY NEW JERSEY STATE HIGHWAY DEPARTMENT

By N. C. Applegate, Equipment Division, New Jersey State Highway Commission, Trenton, N. J.

The State Highway Department of New Jersey has a total of 417 motor vehicles; that is, light cars and trucks, and in addition also has approximately 175 other pieces of power equipment, including rollers, tractors, concrete mixers, steam shovels, pumps, etc., under the direct control for care and operation of the Equipment Division.

The Equipment Division acts as a trucking or equipment contractor to the other State divisions, such as Maintenance, Construction, Bridge, etc., and has full charge of maintenance and care, and method of operation of equipment. The operators of these vehicles work under the supervision of the various superintendents, foremen and engineers, as to hours worked, and work done.

Installation

In reference to the installation of new types of equipment, this is a problem that we have not as yet had to go into very deeply. Practically the only installation in the last year has been the purchase of several one-ton trucks and survey cars, which trucks and cars cover a field by themselves in which no other type of equipment would be suitable. In reference to the installation of the larger type of equipment, all the heavier motor vehicles now in use by the Highway Department are war surplus material. In the distribution or assignment of these vehicles to the various jobs around the state, various local conditions such as amount of material, approximate haul, source of material, whether new construction or maintenance work, and approximate length of time vehicles will be used on that particular job are all taken into consideration.

Standardization

The question of standardization is another problem which does not immediately interest us, due to war surplus material on hand. When six or eight trucks are sent out to take care of a particular job, we endeavor to have all trucks of the same make and type in order to simplify the work of the mechanic in taking care of them. In reference to heavier trucks, we are now using fifteen different makes of trucks and six different makes of touring cars. As stated before, practically all equipment is war surplus material, which has been transferred to the state at nominal cost. However, on gravel maintenance work and patrol units we have practically standardized on one-ton trucks with the tilting hand-dump body.

The question of installation and standardization also becomes difficult, due to the fact that the work on the various jobs throughout the state is not constant. Irregular receipt of material by freight also handicaps us in selection of the type of motor equipment to be sent out on the job as the truck may be used to haul material for several days, and either lay idle, be used for cold patch work, or to transport laborers for several days while waiting for material.

Control

Locations of every piece of equipment are kept posted on a large map of the state showing the different highway routes. Different colored and sized map-tacks, with the various department numbers printed on them, are used to denote different types of equipment. These tacks are spotted on the map as near as possible to the actual place where equipment is located. The map which we use is on a scale of approximately one-half inch to one mile. This map is posted within two or three days after changes in location are made. A card system is also kept which gives full information regarding the piece of equipment, together with the dates the locations of same are changed.

Operation

In our work the season is about seven or eight months long and outside of a few isolated cases the truck would not be in one location on the average for more than three or four months. This makes it difficult to procure and keep competent drivers of the type required in industry. Practically every time that the location of a truck is changed it becomes necessary to change drivers, due to the fact that the older men object to working away from home, and the short season. Most of the drivers want all-the-year-round outside work and object to being placed in the shop throughout the winter season.

Vehicle Inspection

Our inspection was taken care of in the past year by one inspector who covered the entire state. He was able to make the trip once in two weeks. This inspector's duties were as follows: To inspect and make a report as to care of equipment and method of operation, and report same to the Equipment Office, also to make whatever minor adjustments were necessary. He did not, however, do any repair work on these trucks, but in cases where he found it necessary he would phone the central garage, Trenton, and a service mechanic with repair parts would be sent out to take care of the trouble. This year, on account of additional equipment in use, we are planning to divide the state into four districts, each of which would contain between 150 to 200 miles of state highway. One mechanic or, if necessary, one mechanic and helper, would be assigned to each one of these sections to make all necessary inspections and repairs on equipment. They would be held responsible for all equipment in their factory. Oniy in cases of extraordinary trouble such as serious motor or transmission trouble where it was necessary to bring the unit into the shop for repairs would the garage forces be required.

Repairs

We have one central repair shop which is located at Trenton. Practically any part of the State can be reached by a service man with parts necessary within three or four hours at the most from here. Sufficient stock is carried at our central service station to take care of all except extraordinary repairs, on all types fo equipment which we operate, except touring cars, on which we can get service at several different places in the State. While not actually working during the four or five months in the winter when they are taken off the road work, our trucks immediately after the road season are brought into the garage and equipped with snow plows and sent out and kept available at all times for snow removal. Up until the present season we have not had enough equipment "as reserve" to enable us to replace equipment out on snow removal, while these trucks were being overhauled.

Service

As stated in a previous paragraph, parts are carried in our service station for all makes of trucks. We have not found it practical to depend on Philadelphia or New York stock for truck repair parts as in several instances we have found it necessary to secure thes from factories located several hundred miles from Trenton.

Accounting

At present our accounting and costs are distributed in a general way as follows:

Operation of trucks. This menas that operating costs for all trucks are lumped together with no distinction made between different makes and sizes. In like manner all other equipment is lumped; that is, all costs for steam shovels, mixers, road rollers, pumps, etc., are grouped under the general head: "Operating of Equipment" and it is not possible to segregate different types and makes of equipment. It is my opinion that individual costs should be distributed as follows:

Inside repairs
Outside repairs
Gas and oil
Tires
Operators' salaries
Operators' expenses.

The above should be compiled for each piece of equipment each month. This information is necessary for the intelligent working of eqlipment.

Tire Record

At present tires are furnished to us under competitive bidding. In the past very few tire records have been kept, due to the fact that the adjustments which we were able to get under the agreement under which the tires were bought, made the cost of keeping records of tires equal or more than actual benefits that we received from any adjustments.

I believe that transportation by motor vehicles offers one of the biggent fields for efficient organization.

The foregoing matter is from a discussion by Mr. Applegate before the recent annual meeting of the New Jersey State Highway Association.

MOTOR TRUCKS OPERATE ON RAILS IN CITY AND INTER-URBAN PASSENGER SERVICE

Again the motor truck steps into a new field and again it proves its versatility and adaptability beyond question.

For the first time in history, gasoline-propelled cars have been put into city railway service to replace electric trolley cars. This installation has been made by

A Great Truck Value

You will be greatly surprised to find how little more it takes to buy a Packard Truck than to get just an ordinary truck.

In many cases, the first cost of a Packard is actually lower than that of others, and in all cases its final cost is much lower.

Its certainty of performance, its economy of upkeep, and its security as an investment, all combine to make the Packard Truck at its present price the greatest value in the motor truck market today.

It is the product of a company that is known for stability and experience. Prompt service at the fairest of prices for labor and parts is available on it everywhere, through nation-wide Packard facilities.

In its daily operation, the Packard requires a minimum of routine care, and it always returns a maximum of powerful, dependable service.

It is a thoroughbred in design, materials, and workmanship. Its quality is the rugged quality essential for long life, freedom from trouble, and low-cost operation.

Have your Packard dealer quote you the figure at which the Packard Truck is selling today. He is ready to advise with you also on any special or body equipment you may require for the economical handling and hauling of your products.

In more than two hundred lines of business, Packard Trucks are relied on today for better hauling at lower cost.

Packard Trucks range in capacity from 2 to 7½ tons, and in price from $3,100 to $4,500, at Detroit

PACKARD

ASK THE MAN WHO OWNS ONE

Vocational Truck Selection

It is the opinion of many in the truck industry that truck buyers will pay increasing attention to the service rendered by trucks in any specific field in buying trucks to use in that field. Of course this is a natural method of selection but many buyers in the past have not paid particular attention to the performance of truck types in their field before placing their truck orders.

It is held by many that within the next very few years the great majority of all trucks sold will be sold on the **Vocational Plan,** because the public will insist on being shown just what trucks have done and will do in actual operation in the line of business in which the buyer is engaged and not in some outside line.

It is now possible for prospective buyers of trucks to secure detailed and accurate information regarding truck performance in every field.

We can assist you, without charge, in selecting trucks that have made good in the municipal and county construction field if you so request.

Municipal and County Engineering

702 Wulsin Bldg. **Indianapolis, Ind.**

the Manhattan City and Interurban Railway Company of Manhattan, Kansas, which recently scrapped their heavy electric cars and equipment and are now operating four FWD railway cars, manufactured by the Four Wheel Drive Auto Co. of Clintonville, Wisconsin.

A few years ago the idea of operating a motor truck on rails would have been laughed at, yet the chasses for these cars are the same as the chassis used in the standard FWD 3-ton truck with the exception of those changes which are necessary to fit the trucks for rail service. These cars are operating on the same rails over which the electric cars formerly operated and according to the same schedules.

The excessive cost of operating the heavy electric cars for a patronage which has decreased considerably since the war was the deciding reason which influenced officials of the Manhattan City and Interurban Railway Co. into buying lighter equipment. It cost them between 40 and 50 cts. per mile to operate electric cars and they give the public just as good service now at a cost of about 15 cts. per mile. But they gained more than ating a car instead of two; they elimisimply a reduction in operating costs by installing motor equipment; they reduced their number of employes, one man opernated the expense involved in the operation of a power plant and three substations; they are able to operate their motor equipment with less noise and less annoyance to the public; they reduced their cost of maintaining their right of way, the new equipment being much lighter and less destructive to the rails than the heavy electric cars; they reduced the liability of damage suits resulting from accidents, which were quite frequent when the electric cars jumped the tracks. Besides all of these advantages, this company has done its bit toward beautifying Manhattan through the removal of overhead trolley wires and poles from the city streets.

Each car provides seating capacity for 32 persons and a space for baggage. The cars are well finished inside and afford great comfort to passengers. Some of the other features of the cars are as follows: 156-in. wheelbase; high speed reverse gears which enable the cars to go as fast in reverse as they will go forward; locomotive type "cow-catchers"; electric starting and lighting devices; heating systems which utilize the heat from the motor exhaust; entrance and exit near

MUSHROOM TRAFFIC LIGHT
AN ACCIDENT PROOF CAST STEEL
BRILLIANTLY LIGHTED
TRAFFIC MARKER
A unit that is indestructible, and even more conspicuous at night than in the day time.
It has low maintenance expense, no replacements, and is supplied with a Duplex lighting system, insuring constant service.
This unit is in use in over one hundred cities at the present time, giving perfect satisfaction.
The only cast steel unit on the market.
Bulletin on Request
Electrical & Specialty Supply Co.
MADISON TERMINAL BUILDING
Chicago, Illinois

the front of the car with the door operated by the driver. In addition to the rail cars they operate one bus on the highways between Junction City and Fort Riley as a feeder to their interurban line. This bus looks somewhat similar to the rail cars, having the same kind of body. The weight of the chassis in each case is 7,200 lbs., as compared to 60,000 lbs. which is the weight of the heavy and noisy electric cars.

The two cars operating on the city lines average about 95 miles each per day and 500 stops each per day, while the two cars in interurban service average 150 miles each per day and about 250 stops each.

Both in the city and on the interurban line between Manhattan and Junction City, there are many steep grades and sharp curves in the tracks. At one place the cars travel up a 5 per cent grade which is 2,500 ft. long, and another 3½ per cent grade which is 4,000 ft. long. The curves encountered by these cars vary from less than one degree up to a curve with only a 45-ft. radius.

When the first snow of the winter arrived at Manhattan, citizens were doubtful as to the ability of the cars to operate in the snow without the use of a snow plow, as had been the custom with the electric cars. But all doubt was cleared away when the trucks, with little difficulty, plowed through the deep snow which was drifted in places to a depth of 2 ft.

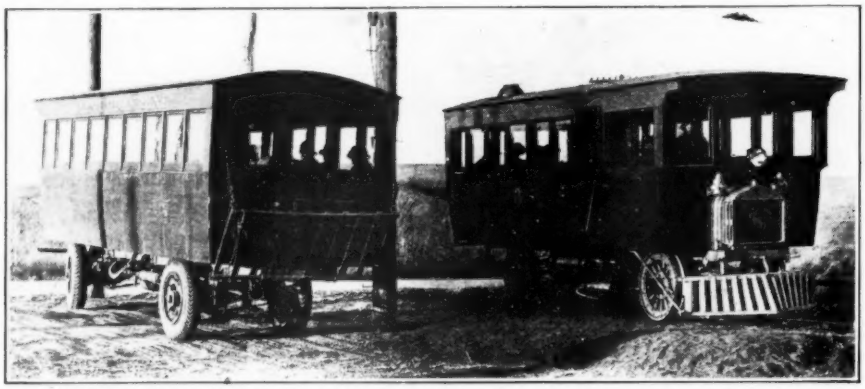
With the load equally distributed over the four wheels and with every wheel a driving wheel, these FWD trucks obtain a maximum amount of traction, which makes them particularly well adapted to service over steep grades, around sharp curves and over snow-covered rails such as they encounter in the service on the Manhattan lines.

Regarding the service given by their motor equipment and the cost of operating it, company officials state that the installation is a great success. They also state that not one complaint about the service with the new equipment has been received, which speaks pretty well for the patrons' satisfaction and which goes to prove that service is the secret of universal satisfaction.

ONE NEW YORK TOWNSHIP WILL LIGHT 100 MILES OF HIGHWAYS

By O. J. Helvey, Lighting Specialist, General Electric Co., Schenectady, N. Y.

The Township of Amherst, New York, which lies adjacent to Buffalo, has decided to illuminate all the highways within its borders, and has entered into a contract with the Buffalo General Electric Company for a lighting system for its entire road milage, a total of about 100 miles. This is the first instance, so far as can be recalled, in which a township has decided to light all its roads.



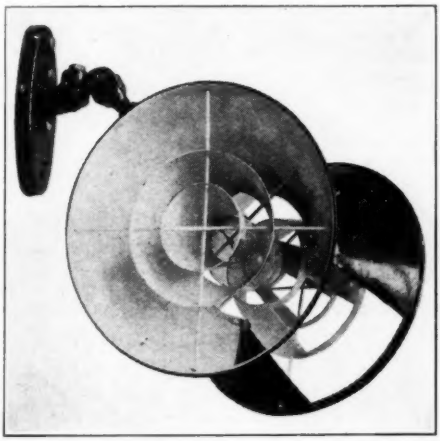
HIGHWAY BUS MAKES DIRECT CONNECTIONS WITH INTERURBAN CARS.

The work will be spread through a period of three years, and the complete installation will consist of between 1,000 and 1,500 units, including those to be placed along the portion of the Buffalo-Niagara Falls boulevard which will be lighted jointly by the Buffalo General Electric Company and the Tonawanda Power Company.

The project is the result of a painstaking investigation made by the supervisor of the township, Mr. John Worley, of all the different methods of highway light-

ing. He made a trip to Swampscott, Mass., and to the Albany-Schenectady highway, where he could view installations of the new G-E highway lighting units in sufficient numbers to enable him to make an unbiased report to his constituents. He also had a few units installed on one of the main thoroughfares so that all who were interested could inspect them.

The contract between the township and the Buffalo General Electric Co., calls for the installation of 212 units at once, the others to be added as directed by the supervisor of the township. These first units will be placed along five miles of the great east-and-west highway leading eastward through the township from the Buffalo city line, one of the great motor travel routes of the United States, as well as along a number of parallel stretches of improved roads, and cross roads. Work on the main road installation, which was begun at the Buffalo city line, has already been started.



BRACKET TYPE SERIES HIGHWAY LIGHTING UNIT.

The G-E Novalux Highway Lighting unit will be employed. This unit has a parabolic nest reflector and embodies certain new features for collecting the light rays and directing them where most needed. Briefly described, it consists of two nests of three reflectors each, with a MAZDA lamp mounted in the center, and the filament at the focal point of both sets. By this arrangement the greater part of the light that otherwise would be lost by reflection upward and outward to the adjoining fields, is collected and cast in both directions on the surface of the roadway. The rays that would escape if only one reflector were used are picked up by the inner reflectors and directed towards the roadway at an angle of ten degrees below the horizontal. A single parabolic reflector would have to be approximately fifteen feet in diameter to give the same effect. The white reflecting surfaces of the unit reduce the glare.

Within this reflector is a 250-candlepower Mazda C series lamp, operating from a constant current circuit. By this arrangement a maximim of more than 4,000 candlepower is obtained from each end of the reflector from a lamp consuming only 153 watts. The bracket holding the unit is adjustable in either a horizontal or a vertical direction, thus making it possible to mount the fixture either on poles near to, or some distance from, the roadway, and to turn it so as to illlminate curves and hillsides.

These are the same type of units as those which have been installed at Swampscott, Massachusetts; along a stretch of the Albany-Schenectady highway; in the vicinity of Detroit, and along the Miami-Miami Beach (Florida) causeway, a thoroughfare over which an enormous amount of traffic passes. It is proposed to install them along the Ideal Section of the Lincoln Highway, in Lake County, Indiana, a section of roadway which will represent the very best highway construction that engineering talent can devise.

In the Amherst installation, the units to be placed along Main street will be spaced at intervals of approximately 400 ft., 30 ft. above the surface of the highway and about 20 ft. back from the shoulder of the road. On the less important highways, such as earth roads, etc., it is planned to space them 600 ft. apart, but the lamps will be of the same size and type—250-c.p. Mazda C. The units are to be operated on General Electric R. O. transformers, the transformers to be turned on and off by means of a time switch. The township will pay the Buffalo General Electric Company $60 per year per unit.

This installation—even considering only that portion of it which is planned for this year—not only is one of the largest yet authorized, but is of especial interest as being, so far as reported, the first instance in which a township has definitely committed itself to the proposition of lighting all its highways.

Why Road Builders Prefer Kentucky Rock Asphalt

Contractors and engineers who have laid or supervised Kentucky Rock Asphalt pavements prefer it to other hard surface types. The reason for this is evident when the advantages of this natural asphalt mix is understood and verified by experience.

Kentucky Rock Asphalt is ready mixed and ready to lay cold on any base adequate to carry the traffic. It is shipped in open top cars and may be unloaded and handled by machinery at a considerable saving. Kentucky Rock Asphalt is not susceptible to damage from the weather. The material may be ordered in at any time and stored in the open at convenient sites along the work, thereby eliminating costly delays.

No expensive equipment is required in Kentucky Rock Asphalt construction. Shovels, rakes and a roller are all the equipment needed. There is no need of skilled or expert asphalt workmen.

Kentucky Rock Asphalt requires no special binder course on curb. The material is spread cold on the base; raked to proper depth and rolled. The pavement may be thrown open to traffic immediately.

Kentucky Rock Asphalt has eliminated the risk of surface failures or replacements. Every contractor knows that in laying the more common types of asphalts, he constantly faces the risk due to human error in mixing, heating or laying. Kentucky Rock Asphalt is uniform, by laboratory test. Exposure to the elements, even for a period of years, does not affect it. Laid on a base sufficient for the traffic, it always gives maximum results.

Foundation replacement is not difficult even after the surface has been laid. The rock asphalt may be cut away and, after the base has been repaired, the asphalt may be broken up and used again in restoring the surface.

Surface irregularities may be corrected without disturbing the pavement. If a slight depression occurs in the finished job, the surface may be roughened and brought to proper grade by adding rock asphalt. The patch, after a few days' traffic, will bond so perfectly that it may not be detected.

The finished Kentucky Rock Asphalt surface is equal in every respect and in many ways superior to sheet asphalt. It is smooth, noiseless, dustless and resilient. Kentucky Rock Asphalt pavements do not crack, roll, buckle or bleed even under the most severe traffic and climatic conditions.

Kentucky Rock Asphalt has been recognized in the standard specifications of ten states. It has been approved for Federal aid on such heavy traffic roads as the Dixie, Jackson and Lincoln Highways and the National Road.

If you are a contractor, anxious to get away from costly equipment and many uncertainties of road and street construction, or if you are an engineer eager to serve your community by building the best pavement at a reasonable cost, it will pay you to investigate Kentucky Rock Asphalt. Write for Booklet E.

Kentucky Rock Asphalt Company
INCORPORATED
711-718 Marion E. Taylor Building **LOUISVILLE, KENTUCKY**

EDITORIALS

INTERPRETING RESULTS OBTAINED ON TEST ROADS

Everyone has recognized the need for impartial, scientific investigations of the carrying capacities and wearing qualities of various types of paved highways under modern traffic. Some elaborate experiments have been made and results are beginning to appear. We are in complete accord with the objects of these tests and have confidence in the ability and integrity of the men in charge. Therefore, it is furthest from our purpose to say anything which will detract from the value of this much-needed experimental work. But we do wish to suggest a proper degree of conservative caution in adopting test results and applying them in designing new roads.

It is exceedingly difficult to evaluate all factors in a highway engineering problem. Oftentimes assumptions must be made before a mathematical treatment is possible and these assumptions are likely to be highly erroneous. We would suggest, therefore, that engineers in interpreting test data look sharply to distinguish between conclusions based on hard facts, from which all uncertainties have been eliminated, and conclusions based on mathematical discussions resting in part on assumptions. The very object of these tests is to obtain facts which are free from the uncertainties born of assumptions, but we fear assumptions will find a way of creeping in unless vigilance is exercised in excluding them.

DIFFICULT DAYS FOR ENGINEERING SOCIETIES

Many engineering societies are now passing through the most difficult days they have ever experienced; they have suffered a loss of income at the same time their operating expenses have been at a maximum. It is not strange that they are hard pressed to make ends meet. The gravity of the situation may be appreciated from the fact that one old, well-established society reports that its members are well in excess of ten thousand dollars in arrears in their dues. This has forced the society to borrow money to pay operating expenses. Another old society has been asking its members to pay dues for the next year within the present year and has managed in this way to pay its present bills; what it will do in another year is not yet clear. At least one society has adopted a method of collecting back dues which will subject it to much adverse criticism unless the profession takes a charitable view of the matter, due to the unprecedented difficulties with which the officers of the society have been, and are still, confronted.

During the boom times of a couple of years ago some societies put on elaborate membership drives and succeeded in putting on a great many new members, thereby greatly increasing operating expenses. With the coming on of harder times, society dues have seemed to come around pretty often and have become increasingly difficult to pay, especially to men who belong to several societies. Many engineers have had their salaries cut and others have been out of employment for considerable periods; many in business for themselves have operated at very small profits and doubtless some have lost money. In view of these facts it is not hard to see why so many society members are in arrears in the payment of their dues. Meanwhile operating expenses have been very high, notably in the printing of proceedings. The result of decreased income, accompanied by increased expenses, has been the placing of a very heavy burden on the officers of many societies.

We bespeak for these officers the support of the profession. They need assistance and not criticism. Their tasks, always difficult, will now prove impossible unless they are supported in every way by the profession.

"SOFT" CITY WATER

Great interest has been expressed by readers in the symposium on the centralized softening of a public water supply published in the March issue of this magazine. The present issue continues the discussion. The topic is one of economic

importance and of timely interest. After being very quiet for several years, water departments and water companies are beginning to take a lively interest in improving their plants and their product. Many are inclined to the belief that the time is near at hand, if it is not already here, when water utilities will no longer be satisfied with their product, however palatable and pure it may be, if it is too hard, as drawn from the tap, for agreeable use in the home and for economic use in industry. The effect of hard water on health is a subject on which general agreement has not been reached, but all are agreed that a hard water is an expensive and troublesome water to use.

Many plants, fortunately for them, are not troubled with this question at all, for they have supplies which do not require softening. Many others, however, have supplies that are hard and many plants are distributing water which should be softened. In general, we believe, and expert opinion seems to support this belief, that it is more economical to soften such a supply at a central plant before it is distributed than in the home and factory after it is distributed. By softening in the home we do not refer especially to the use of household water-softening plants, but to the use of softening powders, hard water soaps, etc. It is unquestionably more expensive to use a hard water than a soft one, whether in the home or in industry, and our advocacy of the centralized softening of an entire supply is based on the belief that water takers can pay more for a softened water than for a hard one and save money by doing so.

The terms hard and soft are, of course, relative. We are not here concerned with definitions; limits have been fixed in the discussions to which we have referred. It is not the purpose of the present discussion to enumerate all the arguments in favor of water softening; those have been well stated by contributors in our Water Works Section. Our present purpose is to urge all water utilities now distributing a hard water to investigate the economic feasibility of softening it at a central plant. The art has been developing for some years and has advanced to the point where experts do not hesitate to recommend centralized softening. It should be understood that where a water utility undertakes this new function it should be adequately compensated for doing so in the form of increased rates.

Space will be devoted to this subject in future issues of this magazine. We are interested in the advancement of knowledge with respect to the subject and this requires the statement of negative, as well as affirmative, views, if, indeed, there are negative views. We wish to present all shades of opinion which are sincerely held by our readers.

AN ENGINEER ON INFLUENZA

In this issue we publish the first in a series of two articles entitled: "Municipal Sanitary Precautions During Epidemic of Influenza." The first article discusses the general aspects of the disease and its epidemics and pandemics. The second article will give detailed recommendations as to measures of public hygiene and sanitation to be instituted by municipalities in coping successfully with this dreaded disease. Those who remember the scourge of this disease in 1918, when people died so fast, in some localities, that they could not be promptly buried, even when graves were made with steam shovels, will not need to be urged to study and preserve these articles for use in the future. Appalling as the thought is, there is every reason to believe that epidemics of this disease will come again, as they have been doing from time to time in past centuries. It is very difficult to prevent the spread of infection; for this reason precautions and preventive measures should be enforced at the very first sign of the appearance of the illness. Here is a case calling for preparedness quite as much as in national defense against a foreign enemy, for influenza may be more dangerous to a nation than any foreign foe, for it does not recognize noncombatants and even the helpless must offer such resistance to it as they can muster.

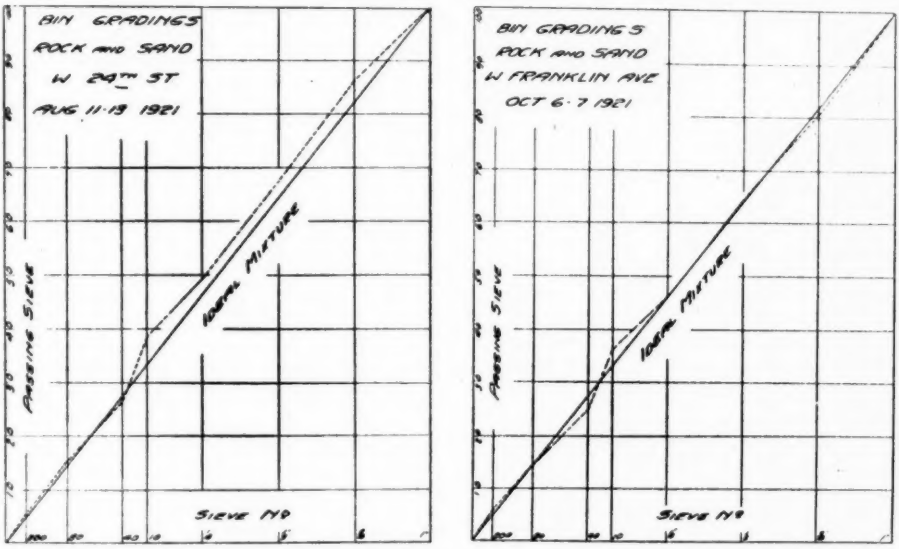
Our contributor comments on the fact that it is astonishing, in view of the fact that epidemics and pandemics of influenza have been occurring for centuries, that the medical profession, with a few exceptions, should not be better prepared to contend successfully with the disease. We are glad to see an eminent engineer turning his attention to the subject.

The editor cannot pretend to have anything remotely approaching expert knowledge on this subject, but he has observed that competent osteopaths have been wonderfully successful in treating influenza cases. We suggest that the individual reader satisfy himself on this point.

CONTROL OF ASPHALTIC CONCRETE MIXES

By Ellis R. Dutton, Asst. City Engineer, City Hall, Minneapolis, Minn.

One of the most essential things about the operation of an asphalt plant is to have an adequate and reliable control of all the material that enters into the mixture. In order to obtain this control it is primarily necessary to know beforehand the proper proportion of the various ingredients that make up the best mixture for the purpose intended. That means that the best available materials in the locality shall be tested in the laboratory by competent men to determine the proportion of each size of the coarse and fine aggregate corresponding to the screens of the asphalt plant which shall be used to make the most dense mixture.



DIAGRAMS ILLUSTRATING MINNEAPOLIS METHOD OF CONTROLLING ASPHALTIC CONCRETE MIXES.

In the ordinary asphalt-concrete plant there are at least three separations of the coarse aggregate and the laboratory determination should be made along these separations. In the present practice in coarse aggregate bituminous concrete the larger particles are those passing a 1-in. screen, and in some cases 1¼-in., but the tendency is toward the smaller size or even smaller. With this larger aggregate there is combined proportions of the other two separations to produce a mixture of the smallest percentage of voids, at least as low as 20 per cent. This is to be filled, and perhaps a little in excess, with the finer aggregate conforming to the standard street asphalt grading.

Having determined this proportion definitely a rectangle is constructed and one perpendicular is divided proportionally into percentages "passing sieve" up to 100. A diagonal line is then drawn from zero to the opposite corner of the rectangle. The other perpendicular is assumed for the largest graded aggregate and lines are drawn from the proper percentage points for the remaining aggregates on the diagonal perpendicular to the base. This will give a definite line for an ideal mixture.

By platting the results obtained from the analysis of the samples it will be indicated diagramatically what variation there may be from the ideal grading and will enable the operator to make such changes in the mixture as will nearly conform to the ideal grading. The idea for these control curves was suggested in Bulletin No. 22, Texas Experiment Station, by Roy M. Green, Assistant Professor of Highway Engineering, and has been worked out by Mr. E. T. Davies, Chemical Engineer for Minneapolis, and E. F. Campbell, Superintendent of Asphalt Construction.

Two diagrams from the records of the Minneapolis Asphalt Plant which show the advantages of this method of control are presented herewith.

The percentage of voids in these mixtures runs from 17 to 18 per cent and the specific gravity of the compressed pave-

ment was about 2.54. The pavement cost, for the top complete laid, about $1.10 average per square yard, 2-in. thick, paying $5 per eight hours common labor and special labor in proportion, $3.65 per ton for trap rock, $1.50 for sand, $2.15 for screenings, $27.45 for asphaltic-cement, $12 for coal and $5.25 for limestone dust.

THE EFFECT OF SOIL MOISTURE ON HIGHWAY DESIGN

By J. L. Harrison, Civil Engineer, East Falls Church, Virginia.

Perhaps the most natural approach to a consideration of the effect of soil moisture on highway design may be had by examining, for a moment, the question as to what is the normal behavior of moisture in the soil. This can be done by noting the factors entering into the normal behavior of soil moisture as the engineer must deal with this moisture. These are, first, the almost universal presence of a body of saturated soil generally but a short distance below the surface of the ground; second, steady evaporation of moisture at the surface of the ground and, third, a constant flow of water from the saturated soil to the surface under the influence of capillary attraction.

The Capillary Flow

A stratum of saturated soil not far below the surface exists in all fertile sections of this country and in most arid sections. The depth below the surface at which this stratum lies (that is, the position of the water table) varies greatly. After long continued heavy rains the water table is generally closer to the surface than after long dry periods. Generally speaking it is closer to the surface on low ground than it is in rolling country or on high land. Also it is generally closer to the surface in dense soil through which the sub-surface drainage is poor than it is in open soil where sub-surface drainage is relatively good. Other conditions too numerous to mention here, affect the level of the water table. The fact may, however, be accepted that a body of completely saturated soil lies at no great distance below the surface in practically all regions where roads are built. From this body of ground-water capillary attraction causes steady upward flow toward the surface. If the rate of evaporation exceeds the rate of this capillary flow the surface of the ground appears dry. If not, it is moist. In any event, whether the surface is dry or moist this steady flow of moisture persists.

Capillary Saturation

We come, therefore, quite naturally to the first and probably the most important relationship that exists between the highway and soil moisture, namely, the fact that all of the higher types of pavement are of such density of surface that evaporation through them is always obstructed and often impossible. Underlying the highway surface there is, of course, the same water table that exists in other places and between that and the pavement, a layer of soil through which capillary attraction is constantly moving water to the surface where, under normal conditions, it would be evaporated. But the highway surface interferes with and often entirely stops evaporation with the result that the soil underlying the surface accumulates the water brought up by capillary attraction until it attains a condition of approximate capillary saturation. This condition is surprisingly constant throughout the year. There are, of course, variations due to a number of causes but generally these variations are relatively small. Thus, in long continued dry weather the moist soil under a pavement may become a secondary source from which moisture is drawn to the shoulders by lateral capillary action. During extreme drought this action may reduce the moisture content under a pavement almost as far as it is reduced in the shoulders. However, such an extreme condition is by no means of frequent occurrence. The more common condition, and the one generally found over the eastern half of the United States, is that in which the soil under the pavement is kept at or near the point of capillary saturation, for the rate of vertical capillary movement is enough higher than the horizontal rate to maintain a high moisture content even during rather extended dry periods.

The amount of moisture that capillary attraction will hold in the soil varies considerably with the nature of the soil. It may be so little as to be of no particular importance. This is the case with gravels and sands that contain no clay. On the other hand, the amount of moisture held by capillary action may be considerable, often reaching and sometimes exceeding 40 per cent in heavy soils. In the latter case the amount of water present is quite sufficient to render the soil plastic like soft putty. Between these two extremes with a marked tendency to approach the latter lie the vast majority of the soils encountered in road building. It is therefore a safe statement that capillary attraction will hold enough mois-

ture in practically all of the soils ordinarily encountered in road building to render them pliable—that is, of a consistency varying from soft putty to hard putty—and that this is their normal condition during the greater part of the year.

Capillary Moisture not Gravitational

Nor is there any way of avoiding this for this moisture is not gravitational; that is, it does not move under the laws of gravitation. Therefore it is quite impossible to relieve the situation by the placement of tile or other forms of drainage. Tile drainage could, in the opinion of the writer, be advantageously used more often than it is, but even where tile drainage is used it cannot reasonably be expected that the load supporting capacity of the soil will be permanently held above whatever capacity the soil may have when saturated to the extent of its capillary capacity. This has led to more or less disappointment where tile drains have been used but it is not so much an argument against tile drainage as against the presumption, too often expressed, that the use of tile drainage will insure a firm, stable sub-grade.

Supporting Power of the Sub-Grade

This view of the matter also has a bearing on another phase of highway design. It has been customary to think of the sub-grade under a pavement as dry. Almost everyone is familiar with the load carrying capacity of relatively dry soils as illustrated by their behavior in what are popularly known as earth roads. Coupling our ordinary everyday knowledge of the carrying capacity of such roads when dry with the ordinary conception of a dry sub-grade, has resulted in assumption that an ordinary highway sub-grade has a high load supporting value. As a matter of fact, this is not the case. On the other hand, it is very difficult to say just what the normal supporting power of a highway sub-grade really is. It is a relatively simple matter to determine the theoretical supporting power of any soil on the basis of a given moisture content, under laboratory conditions and this is, of course, valuable work. On the other hand, it does not by any means solve the problem for we are in possession of practical illustrations of the fact that higher loads than those indicated by laboratory experiments can be carried under field conditions. For instance ,the load on the sub-grade that is caused by a heavy engine moving at a high rate of speed greatly exceeds the loads generated by the ordinary forms of highway traffic and exceeds the theoretical supporting power of moist soils as developed by laboratory test. Yet neither the railroads using light ballast or those heavily ballasted are required to stop their train service on account of even protracted rainfalls at which times the moisture content of the soil, immediately underlying the ballast, undoubtedly exceeds anything capillary action could hold in the soil under a highway pavement. It is true that there is some distortion immediately under the loads as the trains move over the track and it is highly probable that this distortion extends into the sub-grade but, in practice, this does not work to the great detriment of the track, largely because of the facility with which track can be realigned if unduly distorted. On the other hand, the conception of a moist yielding sub-grade as distinguished from the more ordinary conception of a dry and unyielding sub-grade should tend to encourage the construction of deeper pavements in order thereby to distribute the load on the sub-grade more in conformity with the carrying capacity of the sub-grade. This is bound to have a marked effect on gravel and macadam design and should, the writer believes, also have a bearing on the design of pavements of the rigid types, for pavements cannot be readily realigned when once distorted.

The above general statement has been drawn to depict the simplest possible conditions that can occur in the soil. It may, therefore, be well to note that, though the general result is not thereby affected, the actual conditions prevailing are not quite as simple as the above statement might make it appear. The actual movement of moisture to the surface is more apt to be from secondary bodies of partially saturated soil lying above the water table than from the water table itself. Moreover, from time to time rain falls and is absorbed by the soil on which it falls. Its downward movement is partly gravitational and partly by capillary action. Long continued rains not only raise the water table but increase the amount of water held in the soil which overlies the water table, bring it, in fact, to a point of complete capillary saturation. This merely acts to affect the rate of capillary flow, but it does not otherwise modify the general processes going on in the soil. It has, therefore, little effect on the moisture conditions under the pavement because, for reasons outlined above, the soil under a pavement is at or near the point

of capillary saturation in any event. This has been mentioned, however, because besides alluding to the more complicated processes governing, it offers a complete explanation of the fact that the spring and summer rains seldom affect the stability of pavements even though of unusual duration, the simple reason being that as it is already in a condition approximating capillary saturation, the storm water moves downward without modifying the moisture content of the sub-grade.

The Early Spring Sub-Grade Condition

One other condition of common occurrence may well be mentioned. This is the early spring sub-grade condition which results in so many pavement failures. The causes are quite as simple as those outlined above and quite as uncontrollable. Briefly, it is recognized by all engineers that the load supporting power of soils falls off rapidly as water is added. If the amount of water exceeds that which is controlled by capillary action, the lack of stability becomes very marked. For this reason, tile drainage must be resorted to whenever there is any danger that the ground water may rise to a point of undue proximity to the pavement. Just what the minimum separation should be will depend on such questions as the stability of the saturated soil, the loads to be carried, the smoothness of the pavement, etc., but whatever solution is adopted in any given case, the necessity for this separation is recognized by all highway engineers and whenever there is danger that the water table will approach too close to the pavement, tile or other drainage is freely used.

But there are large sections of the country where, during the winter, the soil is frozen to a depth often amounting to a number of feet. After the spring thaws begin it is often a month or more before the frozen layer completely disappears. This is a condition well recognized by drainage engineers—particularly those familiar with the tile drainage of farms—as it has a definite bearing on the functioning of such systems and on the unwatering of farms in the early spring.

But during the period when the surface of the ground is thawed out but before the frost has left the ground, such moisture as falls is absorbed in the surface layer that is free from frost, for it, of course, cannot penetrate the still frozen stratum. The result is a complete saturation of the soil on the immediate surface of the ground with such loss of stability that in walking over fields one sinks appreciably into the soil. This condition is so common an occurrence in the early spring that everyone has experienced it repeatedly. If the rainfall at this period is considerable, the condition will persist until as much as a foot of soil has been thawed out but thereafter it gradually disappears as the rainfall at this time of the year is seldom sufficient to completely saturate more than this amount of soil.

The result of all of this, so far as the ordinary pavement is concerned, is to produce a condition of instability identical with that which exists when the water table rises to or above the bottom of the pavement. Indeed, the spring thaw often actually does produce a secondary water table an inch or two below the surface of the ground as may be determined by digging a small hole to the frozen ground. If a water table exists the hole will partially fill with water, which such a hole will often do. This condition affects the stability of highways whenever it persists for a considerable period and the amount of rainfall during this period is sufficient to maintain a secondary water table at or just below the bottom of the pavement. In such cases the result is very similar to what every highway engineer would expect if the primary water table rose to the bottom of the pavement —distortion, ruts, and areas of rapid failure.

No Solution Is Obvious

It is always unfortunate to have to present unpleasant facts with no offer of a solution for the difficulties that these facts represent. However, no solution is obvious. Of course a recognition of the fact that the bearing power of the soils under modern pavements is less than has been supposed—in short, that for them the "dry" sub-grade is non-existent—will ultimately lead to the use of deeper surfacing in order thereby to better distribute the load. It is interesting to note in this connection that the deep pavements of Massachusetts and Rhode Island have given remarkably good service, no doubt for this reason. But such pavements are expensive and so there is a tendency to avoid them if possible.

The Thick Pavement

Deep pavements also suffer less during the spring thaws than do shallow pavements. Rains during the spring thaw often saturate the top 6 ins. of the ground, they sometimes saturate the first 12 ins., but there is less and less likelihood of complete saturation under the pavement

as the depth of the pavement increases. Deep pavements are, therefore, the most obvious solution of this problem. Other solutions may present themselves and laboratory experiments may develop new methods of treating sub-grades that will reduce the baleful effect of moisture, but of one thing the highway engineer may be absolutely certain—namely, that tile drainage never has and never will solve these difficulties, for the water that keeps the sub-grade wet in summer is moved by capillary action and so is not influenced by the presence of tile drains and that which assists in the ruination of pavements during the spring thaws is completely cut off from any tile drainage system by an intervening layer of frozen ground.

CONSTRUCTING THE TURKEY CREEK SEWER IN KANSAS CITY, MISSOURI

By Paul A. Hartung, Mem. Am. Soc. C. E., Engineer of Sewers, City Hall, Kansas City, Mo.

Kansas City, Missouri, is now engaged in the construction of what is known as the "Turkey Creek Sewer," which will provide against flood water menace to the vast terminals and industries lying in the western portion of Kansas City, not only from the Kansas River but also from Turkey Creek.

Turkey Creek, long a menace to shipping and other industries, including Kansas City's Stock Yards, has its source in Johnston County, Kansas, and flows in a generally northeasterly direction through Rosedale, Kansas, into Kansas City, Missouri, thence back again into Kansas City, Kansas, and discharges into the Kansas River at a point two miles from where this stream becomes confluent with the Missouri River.

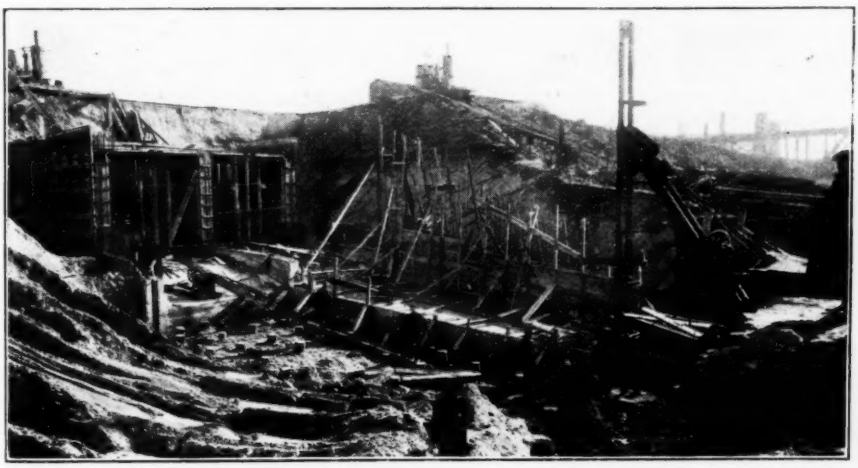
Turkey Creek is a small stream, and serves a narrow valley approximately one-half mile wide. Its alignment is very tortuous, with a gradient of 40 ft. per mile. It is subject to frequent cloudbursts, which concentrating rapidly discharges approximately 20,000 cu. ft. per second.

After reaching Rosedale it is obstructed by numerous railroad trestles and bridges for streets which cause it to leave its channel and destroy traffic and industry; water has been known to rise to a height of 16 ft. at 28th Street and Southwest Boulevard.

The World's Largest Sewer

The Main Sewer is the largest, in the writer's knowledge, ever constructed on this continent or abroad, the main section being twin boxes each 17 ft. in width by 18 ft. in height, the overall dimensions being 39½ ft. in width and 23½ ft. in height, containing 13.5 cu. yds. of concrete and 1,975 lbs. of steel per lineal foot, the average cut from the surface to subgrade being 40 ft., gradient 0.20 and having a discharge of approximately 1,000,000 g.p.m.

The Main Sewer is being constructed to withstand an internal pressure of 9 lbs. per sq. in. and receives all tributary sewers having their source above an elevation of 35 ft. (Kansas City, Missouri, datum), the same being the top of the dike of the



VIEW OF COMPLETED OUTFALL STRUCTURE, SHOWING SEWER APRON IN FOREGROUND, TURKEY CREEK SEWER, KANSAS CITY, MO.

Kansas River, and comprises the following sections:

17x18 ft. Twin Box, 1,750 lin. ft.

15 ft. 8 ins.x16 ft. Twin Box, 495 lin. ft.

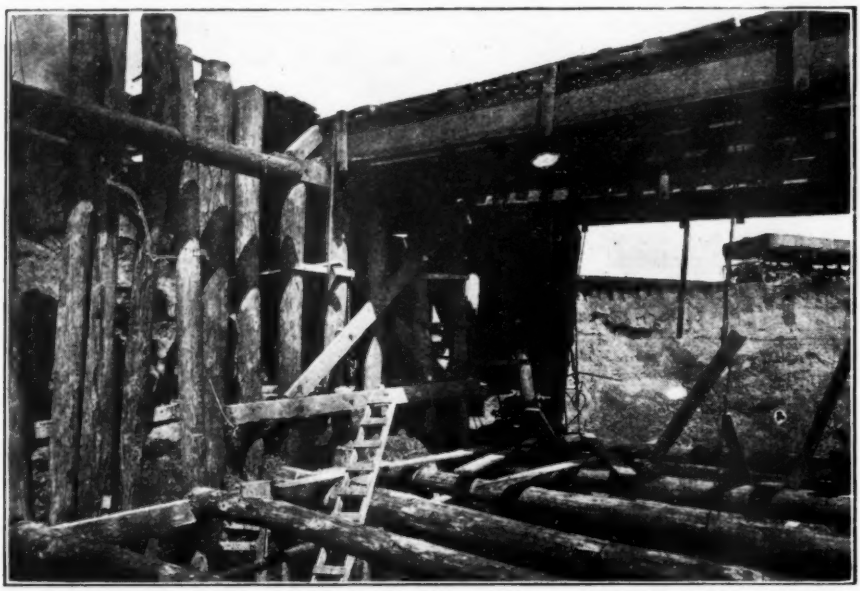
12 ft. 10 ins. Horseshoe Section, 2,340 lin .ft.

11 ft. 4 ins. Horseshoe Section, 1,384 lin. ft.

8 ft. 10 ins. Horseshoe Section, 1,297 lin. ft.

7 ft. 10 ins. Horseshoe Section, 1,017 lin, ft., and various others ranging from 78 ins. to 30 ins.

The low level sewers comprise all sizes of Vitrified Clay Pipe and Monolithic Concrete from 8-in. to 30-in., and are served by two pumping stations which during high water stage discharge into the Main Sewer.



VIEW SHOWING METHOD OF BRACING WHEN PASSING UNDER RAILROAD TRACKS ON TURKEY CREEK SEWER CONSTRUCTION.

Sewage Pumps

The Pumping Station at 25th Street will be equipped with two 30-in. vertical volute double suction centrifugal pumps with a capacity of 30,000 g.p.m. against a head of 30 ft. and two 30-in. horizontal volute double suction centrifugal pumps with a capacity of 30,000 g.p.m. against a head of 15 ft., these pumps to be driven by two 300 hp. vertical slip ring motors at 450 r.p.m. and two 150 hp. horizontal slip ring motors at 400 r.p.m.

The Southwest Boulevard Pumping Station will be equipped with two 30-in. vertical volute double suction centrifugal pumps, having a capacity of 30,000 g.p.m. against a head of 30 ft, these pumps to be driven by two 300 hp. vertical slip ring motors at 450 r.p.m.; both stations contain smaller pumps.

The total length of sewers of all sizes constructed under this project include the Main Sewer of 8,283 lin. ft. and Lateral Sewers of 21,358 lin. ft., or a total of 5.55 miles.

The location of this project (a large portion of the same being built within the old channel of Turkey Creek, and its vast proportions, makes the construction of the sewers at times extremely hazardous and expensive.

Construction Difficulties

At the time of construction of a portion of the 7-ft. sewer lying in the old bed of Turkey Creek, a proper foundation could not be found for a depth of 17 ft. Piling was resorted to and after placing the same in leads an ordinary steam hammer was allowed to rest upon the pile, the weight alone causing a penetration of 17 ft. without a blow. The piling was then driven through 3 ft. of hardpan to solid rock, but the slime and mushy condition of subgrade would not allow the placing of steel and certainly would not sustain the weight of concrete footing. To overcome this condition, a double course of 2x12-in. lumber grillage was laid and fitted in between the piling at cutoff,

both courses placed diagonally across trench. After the concrete had been poured instrumental tests were made for settlement, but none was found in any case.

This method was followed in a portion of the 4 ft. 4 in. sewer until the Penn Lubric Company's plant on the Southwest Boulevard was reached, where it was found to be impossible to drive piling on account of the location of Switch Towers adjacent to the sewer, as any settlement due to driving piles would have placed them out of commission; therefore a new method had to be adopted. Accordingly the muck and sediment which had been accumulating for years in the bed of Turkey Creek was excavated to the depth of 2 ft. below subgrade, which was later filled with large rubble stone. This had a tendency to press the muck up through the interstices as the large rock settled. When this course came to rest a course of small crushed stone was used to fill the interstices upon which the footing was poured. (Instrumental tests have not shown settlement.) In addition to the steel shown upon the plans, four railroad rail at 60 lbs. were placed longitudinally with lap points at 25 ft.

When better foundation was found the course of rubble stone was discontinued and a single course grillage was used, the same being necessary to prevent the steel from becoming coated with mud and also to prevent concrete from sinking into and becoming mixed with the mud. In other words, this portion of the sewer is laid upon a plank floor.

From Station 0+00 (the beginning of the Main Sewer Twin Box) to Station 13+00, foundation was found in a course of dry sand, but at this point the water plane of Turkey Creek was encountered and while an excellent foundation was found, the sand disappeared and a tough gumbo saturated with water (but underlaid with a strata of coarse sand 2 ft. below subgrade) which workmen soon transformed into a loblolly. It was found necessary to resort to one course of 2x12-in. grillage for reasons before mentioned.

VIEW SHOWING SECTION OF INVERT AND PILE DRIVING IN 11 FT. 4 IN. SECTION OF TURKEY CREEK SEWER, KANSAS CITY, MO.

The Main Sewer in traversing its total distance intersects and crosses under 36 railroad tracks. The railroads, to further progress in the construction, have abandoned some of the tracks temporarily. These are chiefly industrial tracks. But where main lines were crossed it was found to be expensive and hazardous, many ingenious methods of bracing being used. Where it became necessary to maintain traffic upon main line tracks, piling 60 ft. in length were first driven on a line with the outside dimensions of the sewer, spaced 3 ft. on centers. These were capped and three 24-in. I beams 60 ft. in length were bolted together and placed under each rail. As the excavation proceeded downward, 12x12-in. whaling were placed along the piling, and piling 40 ft. in length were used as shores. These braces were placed on 12-ft. centers (vertically) but with this care some of the piling were fractured and allowed many serious cave-ins. Excavations are being made with drag line and clamshell, and

placed in cars and deposited as back-fill upon the completed structure.

The "Blaw" Steel Forms both inside and outside have been used exclusively in the construction of the Main Sewer.

Concrete is being mixed in the proportion of 1-2-4 (Class "A") using 40 lbs. of Hydrated Lime per cubic yard, and is deposited in chutes from a movable tower erected upon a specially constructed carriage containing two 1-yd. mixers, sand and stone hoppers, which are kept filled with material (which is deposited near the mixing plant) by the use of a clam-shell.

Where the Main Sewer discharges into the Kansas River a special outfall is being constructed at a cost of $125,000. This is built upon piling at 4 ft. on centers, driven to rock, at such an elevation below the bed of the river as to prevent erosion.

The contract for this work was awarded Thomas Kelly & Sons, of Winnipeg, Canada, (later changed to Kelly-Dennis Co.) in August, 1919, but owing to financial and bonding conditions at that time (surety bond being in the sum of $1,000,000) active work was not commenced until October, 1920. The work has been so prosecuted that at this time 60 per cent has been completed and with favorable weather conditions, should be completed in November, 1922.

The total cost of work will be $2,500,000, payable at completion in Special Tax Bills issued against property embraced within a Joint Sewer District covering an area of 5,000 acres and containing some of the most valuable property in Kansas City, Missouri.

SUBURBAN PLANNING

Charles F. Mebus, Consulting Engineer, 151: Land Title Bldg., Philadelphia, Pa.

Much has been said and written about Town Planning and a great deal has been accomplished in the larger cities where the engineering departments are in charge of men of high attainments, and where the city council or commission usually is wide awake and anxious to make its own city as fine as possible.

Evils of Unrestricted Planning

But beyond the limits of the larger city lies, in a sense, the great unknown, where the real estate operator, the country surveyor, or owner of a tract of land, which has become too valuable to be farmed profitably, may without any restrictions, subdivide a tract into building lots and offer them for sale to the unsuspecting buyer under the alluring terms of "$10 down and $1 a week secures your lot." This vacant lot game which was, in the east, before the war, at a very low ebb, suddenly sprang up again through the shortage of houses and the further fact that many people had money as never before, so plots were "cut up" and sold by the thousands in 1919 and 1920.

Large industries must often change their location to the country to expand properly, or to obtain sufficient ground to construct more modern shops, thereby necessitating the formation of new communities; again, new lines of transportation and the paving of main lines of highway, make it possible for those working or doing business in the city to live farther out. So a little money, the good roads and the cheap automobiles have, during the past few years been a wonderful asset to the vacant lot promoter.

The more intelligent person often considers the thing a good joke and laughs at the poor dupe who has invested in a piece of ground that fronts on a street which it is possible to find only by the aid of the corner sign post and long rows of lot stakes on either side; where there is no established grade; no restricted building line or any other restrictions. So houses may be built of anything, anywhere, and at any height with reference to the surface of the ground. Surely, this is a "free country"—no restrictions.

The so-called "land developer" thinks of but two things, viz: the largest possible number of lots he can carve out of his tract and the cheapest and quickest way to pass the lots on to the buyer. The future problems of the municipality, which are in this way created, are entirely ignored, for the "developer" holds but a minor interest and is working new fields by the time the municipal troubles of his customers and their successors become serious.

What Comes After the Inept Town Planner?

As the number of lots built upon become more numerous, the necessity for municipal improvements increases, and generally a new municipal unit is created or the limits of the adjoining one are extended to include the new development. Then the troubles begin, for the municipal authorities are confronted with making the best of a bad job. Street grades must be established, regardless of the fact that some houses will be left up high and dry, and others way down in the hole. A system of surface water drainage becomes

necessary, but the ravine goes through some fellow's front or side yard and he wants it taken somewhere else, no matter where, only so it costs him nothing and inconveniences him not at all. Sanitary sewers must be installed, but as system of street grades were not established in advance, deep and expensive sewer excavations are necessary to drain to a common point, which as like as not has no ground available for a sewage disposal. Surely the streets need paving—for what use is an automobile without paved streets, but my constituent who has strained every nerve to buy a lot, erect a bungalow with garage and buy an automobile is about "all in" financially and cannot conceive why he should pay his share of the municipal improvements, which he demands, on the per front foot assessment plan. So resort is often had to bond issues, which by the time the improvements are paid for, cost two to three dollars for each dollar of original cost. But in the meantime, other improvements are needed, and the tax rate soars, much to the disgust of the tax-payer and to the discomfort of the public official. Nor is this all. Park spaces, play grounds, community centers, school grounds, etc., are usually omitted and the growing town must acquire building lots for such purposes at excessive costs. I have dwelt on these ills at some length, as I find them to exist in most growing communities.

Procedure in Abington Township, Montgomery County, Pa.

Abington Township, Montgomery County, Pennsylvania, which lies within the suburban area of Philadelphia, has an assessed valuation of over $13,000,000, contains 16½ square miles and has a population of about 9,000 people, who live in nine separate villages. The township has a commission form of government, and is one of the 43 similar units in this State. Of late years it, too, has suffered greatly from the conditions just described.

Its Board of Commissioners has been instrumental in forming a State League of all these townships for the purpose of obtaining more favorable state legislation. To control the planning of sub-divisions, the legislature last year passed an act which provides that all plans or plots of land shall be approved by the Township Commission before they may be recorded, and also provides a penalty of $500 against the Recorder of Deeds for filing plans not so approved.

Rules for Laying Out Sub-Divisions

Immediately upon passage of this act our Highway Committee formulated the following set of rlles governing the laying out of sub-divisions, which must be substantially complied with before the commissioners will approve said plans.

Plans must give:

1. Complete block and lot dimensions, including angles, radii of curves and length of arcs. Blocks must not exceed 800 ft. in length.

2. Locations of all street monuments must be shown at street intersections, angle points and beginning and ending of curves.

3. Widths of streets, widths of sidewalk, position of curb line and building lines must be given.

4. Curb grades must all be shown.

5. Reservation of right of way not less than 20 ft. wide along natural water courses, for the township to construct and maintain sewers, is required.

6. Plans shall be filed with Township Clerk in triplicate, preferably prints on cloth.

The Board further requires that streets shall have a minimum width of 40 ft. for residence streets and from 50 to 60 ft. or more for main streets; lots shall not be less than 20 ft. front or less than 100 ft. deep. Building lines shall not be less than 10 ft. inside of street line. Sidewalks shall not be less than 8 ft. wide and all curbing at street intersections shall be circular curves with a radius of not less than 15 ft., and greater for sharp corners.

No dead end streets or offsets at street intersections will be approved, and in general sub-divisions shall be so laid out that adjoining property may be sub-divided and connected with the sub-divisions under consideration.

The approval of a plant of a sub-division does not obligate the township or the does not obligate the township or the owner to grade or pave the streets.

The Board further reserves the right to make additional requirements which it may deem necessary.

A marked improvement has already been made in street layouts and the more progressive real estate men greatly favor the new regulations.

We hope to further control the sub-division of property by the organization of a park and planning commission.

MUNICIPAL SANITARY PRECAUTIONS DURING EPIDEMIC OF INFLUENZA

Rambling Thoughts of a Civil Engineer

By Dr. Wm. Paul Gerhard, C. E., Consulting Engineer, 17 West 42d St., New York, N. Y.

PART ONE

The recurrence of the influenza epidemic in New York City during the early part of 1922, while not in as severe a form as the one which prevailed in the autumn of 1918, and which then traveled across the entire continent and affected numerous large as well as small communities, vividly reminded the writer of his personal experience in October, 1918, during an extended visit in a manufacturing and railroad town in Western Maryland.

Its population numbered about 27,000 persons, among whom about 6,000 cases of influenza occurred, many of them followed by pneumonia. The majority of cases were found in two industrial sections of the city, where the housing conditions of the workingmen, and the sanitary conditions in general, were not of the best.

No accurate returns were available because physicians became overworked. Nearly 200 deaths from pneumonia, following the influenza attack, occurred. Owing to the demands of the war, physicians as well as nurses for the sick were lacking, hence many persons volunteered from private life for nursing, ambulance and Red Cross service. Undertakers and cemetery workers became overburdened with work, funerals had to be either unduly hurried or the burials delayed. After three or four weeks of strenuous anxiety the epidemic began to subside.

The appalling calamity which befell this town was repeated in other places. In fact, the epidemic had become a panedemic* in the United States. One could not help observing the fact, which has recurred more than once in history, that "world wars and epidemics sometimes go together."

"An epidemic may well be likened to the sudden uprising and uproar of a gale, which in its mad fury uproots strong and healthy trees. Death comes, clad in a dismal and strange raiment; it shakes the nerves of the strongest and bravest of men. People feel that the causes leading to the calamity were avoidable and that the epidemic might be due to man's indifference or carelessness in sanitary matters."**

The foregoing reference applies primarily to epidemics of cholera, typhoid fever, the plague and other contagious diseases. It appears to be a mooted question whether influenza should be included in the list. At least one medical authority claims that "sanitary conditions other than overcrowding have no influence on the spread of the epidemic." The writer of this essay is not prepared to endorse this view, as his observations and reflections will show.

What Is Influenza?

An editorial Committee of the American Public Health Association answers thus: "Something is known concerning the nature of influenza, but much remains to be determined."

Physicians generally seem to know comparatively little about the disease except:

(1) That it is an acute febrile disorder, of a high degree of infectiousness, said to be due to a specific bacillus, discovered by Pfeiffer in 1892, a microorganism described as being of peculiar robustness and virulence:

(2) That the disease lowers the resistance of the respiratory organs;

(3) That pneumonia, which often follows it, is unusually fatal; and

(4) That frequently reconvalescence is slow owing to the weakening of the entire body. The disease seldom occurs in sporadic cases; as a rule it comes in the form of an epidemic, and sometimes as a pandemic, as the historical notes will show.

Influenza seems to be almost independent of the seasons of the year, of the climate, and of the weather. Usually there are more cases in winter time, reaching a maximum in January, when people are less in the open air, and a minimum in August. Influenza occurs in all zones and in all latitudes, at sea level as well as on high mountains; it attacks persons of all ages, neither children nor old people being exempted, but by far the majority of cases occur between the ages of 25 and 40. It still remains a matter of doubt whether one attack gives a person complete immunity after recovery.

While some observers claim that the microorganism has not yet been identified, it is conceded that it is carried in the matter coughed, sneezed, or spat out from nose or mouth of infected persons. Whether inert articles, such as toys, pen-

* PANDEMIC signifies spread over a whole nation.

** Quoted from a chapter in GERHARD'S "SANITATION AND SANITARY ENGINEERING."

cils, parcels, paper money, letters, clothing and shoes, when handled by patients, can contribute to the spread of the disease, is a matter about which there are differences of opinion. The disease is spread chiefly by human contact or intercourse, and travels mainly along the lines of intercommunication. Persons congregating in large numbers, and confined in closed halls, offices, workshops, or in conveyances of all kinds contribute a high percentage to the sick list.

Historical

Contrary to popular belief, influenza is not a new, nor is it a mysterious, disease. The best historical data, perhaps, are given in a treatise on INFLUENZA, published by Dr. A. Ripperger in 1892 in Munich, Bavaria. According to him, influenza became known as such first in 1387, and he enumerates the following years in which epidemics occurred in the past centuries:

1311	1403	1510	1675	1729-30	1802-03
1323	1427	1557		1732-33	1830-32
1327		1580		1775-76	1833
1387		1593		1780-81	1836-37
				1782-83	1847-48
				1788-89	1889-90
					1899-1900

According to another authority there are recorded about 100 epidemics in the 800 years prior to 1889. In Italy the disease was called "Influenza" owing to the belief that certain evil currents flowed from the stars to the earth. In France it was termed "La Grippe," in Germany the "Russian catarrh." The sudden cessation of some epidemics was popularly attributed to earthquakes and volcanic eruptions.

One of the recent severe epidemics occurred in 1889 and 1890; it traveled from Central Asia and Siberia to European Russia and to Sweden, and soon afterwards the whole of Europe became involved, and likewise the United States.

In London the percentage of persons taken ill was:

among outdoor workers...12.5%
among office workers.....25 %
among the troops..... 9.3%

The proportion of population involved in other cities is well shown by the following authentic statistics:

in St. Petersburgh and in Buda-Pest..50%
in Berlin 33%
in Nuremberg 67%
in Antwerp 33%
in Vienna.....from 30 to 40%

During the later epidemic of 1899 there occurred in England 12,417 deaths.

In the widely spread pandemic of 1918 the disease began with a sudden outbreak in Boston; it apparently entered New York City in September by a Scandinavian steamship, which brought over 11 cases. The rapid spread of the epidemic in New York City is shown by the following statistics from the N. Y. Health Department for September and October:

NEW CASES

Week Ending	Influenza	Pneumonia
Sept. 22, 1918.....	127	0
Sept. 29, 1918.....	1294	231
Oct. 6, 1918.....	9270	185
Oct. 13, 1918.....	23077	2433
Oct. 20, 1918.....	33363	4064
Oct. 27, 1918.....	26166	4490
Grand Total	93297	12369

DEATHS

Week Ending	Influenza	Pneumonia
Sept. 22, 1918.....	0	0
Sept. 29, 1918.....	42	119
Oct. 6, 1918.....	59	96
Oct. 13, 1918.....	1050	1261
Oct. 20, 1918.....	2393	2086
Oct. 27, 1918.....	2497	2015
Grand Total	6325	6032

On some days there were more than 5,000 new cases in New York, and the epidemic ran its full course despite preventive measures.

In Pennsylvania, Massachusetts and other States the epidemic was equally severe. It raged with special severity in the United States Army camps. It also spread to Canada, from Quebec to Vancouver, and traveled in one month from the Atlantic to the Pacific shores.

In the United States the pandemic cost about 450,000 lives, while in England the mortality was higher than in any year since 1850. Due consideration should be given to the fact that the records of mortality were more completely kept than in previous pandemics. The epidemic of 1918 attacked chiefly the 20 to 40 years of age group, in contrast to the belief that persons of that age would show a better resistance. It is a matter of general observation that pandemics of influenza continue for several years, and so we see it again active in 1920 and 1921.

Its recurrence in the winter of 1921-22 was largely confined to New York City. According to the U. S. Public Health Reports, New York City showed the following number of influenza cases:

Week	1st	2nd	3rd	4th	5th	6th	7th	8th
1922 ..	56	59	110	1230	5731	7070	3284	1312
1921 ..	134	78	84	72	59	84	109	102
1920 ..	100	384	5690	30456	21388	8091	3030	1069

The following comparison of deaths due to influenza and pneumonia combined from 36 cities in the U. S. is of interest:

Week	1st	2nd	3rd	4th	5th
1922	671	761	823	863	1051
1919	3165	3346	3688	3756	3180

In Europe the last influenza epidemic

appeared in December in Belgium, Norway, Sweden, Denmark, Italy, northern and southern Germany and in Turkey.

* * * * * * *

Is it not astonishing, in view of the facts cited, showing that there have been for many centuries epidemics and pandemics of influenza that the medical profession, with a few exceptions, should not be better prepared to contend successfully with the disease? In defense, attention should be called to the fact that it is extremely difficult to prevent the spread of the infection because:

(1) The period of incubation is shorter (1 to 3 days) than in other infectious diseases;
(2) The disease is infectious before the true nature of the illness is diagnosed;
(3) Because some patients, not unlike "walking" typhoid fever cases, have only mild attacks, continue to go out, and thereby contribute to the spread of the influenza.

Accordingly, precautions and preventive measures should be enforced at the very first sign of the appearance of the illness. Health boards should not wait until after it has spread.

All prophylactic measures of both *personal* and *public* hygiene are based, directly or indirectly, upon preventing infectious secretions from mouth or nose from reaching the mucuous membranes of other persons. Personal measures are of interest chiefly to physicians, nurses and patients, hence need not be considered here. The measures, which concern the public and which we find suggested in health department bulletins and in the daily press are those recognized universally in municipal sanitation and in good hospital practice. Sunlight and fresh air are two of influenza's greatest enemies. Thus, in a Chicago fresh air school only 3 out of 700 pupils took the disease.

TYPES AND COSTS OF PAVEMENTS SUITABLE FOR TEXAS CITIES

By Julian Montgomery, City Engineer, Wichita Falls, Texas

On small paving jobs in Texas, and in the smaller cities, one course concrete pavement, or brick pavement on concrete foundation, probably would be the standard type that could be laid the cheapest, because of the small amount of equipment necessary as compared with that required for the hot mix bituminous pavements. These pavements would especially be cheaper if good local material were available. It is true that the concrete pavement requires some four weeks for curing. It is also true that patching concrete pavements properly is a slow, painstaking job, which at times requires that the streets be barricaded for several days. However, in the smaller places the traffic is not so congested and neither is the matter of some four weeks of time so important.

Study of 65 of the Smaller Town Pavements

In these smaller places probably the vitrified brick would be used most in the business section rather than in the residential district. A study of the types of pavement in 65 of the smaller towns and cities of Texas shows that vitrified brick and Portland cement concrete predominate in three-fourths of them. It is also likely that when some of our larger cities were smaller, types other than the bituminous ones were laid first.

When the towns develop into cities, and the cities grow larger and larger, the congestion of traffic by commercial and pleasure vehicles demands a rigid economy of time necessary for the construction of the pavements, and also for their maintenance.

Fifth avenue, New York, the most heavily traveled street in the world, is paved with sheet asphalt. The traffic is fairly light and quick moving. This type of pavement is excellent for Fifth avenue. It can be quickly repaired and stands up well under the types of traffic seen on Fifth avenue. For a dense traffic composed of heavy trucks, wood blocks or vertical fiber brick probably would be better types.

The larger cities always have enough pavement construction in view to warrant the construction companies engaged in laying bituminous pavements to install the comparatively expensive machinery necessary to lay this type. Bitulithic, Rock Asphalt, Willite and asphaltic concrete are some bituminous types with which practically every city official in Texas is familiar.

The residence districts in the cities demanding pavements usually give attention to the aesthetic considerations, or the pleasing effects of the pavement. The citizens usually prefer to pay more, if necessary, to obtain a type of pavement that will add the most beauty to their streets. The city officials also consider the pleasing effects, and rightly take the experience of the contractor into consideration. They realize from their own

experience that an inexperienced contractor cannot put the finished effect to the work no matter how hard everyone tries to help the work along.

Preferred Types in the Larger Cities

A questionnaire sent to the City Engineers of the larger cities in Texas shows that the preferred types of pavement for the business districts are the vertical fibre brick and asphaltic surfacing on concrete base. Of the asphaltic types preference is given to the Bitulithic pavement. During the past year it has been practically impossible to obtain paving brick. In the city of Wichita Falls we have not considered brick on that account, and the very high prices of brick pavement. Reinforced concrete pavement is now the cheapest pavement we are laying in the business district. This, however, has its drawbacks, as it causes the merchants considerable loss in keeping the street closed some four weeks for curing.

The questionnaire also shows that for the residence districts the preference is practically unanimous for an asphaltic type of surfacing on either concrete or rock base, depending upon local conditions.

A study of the pavement development in the cities and towns of Texas shows, therefore, that concrete and vitrified brick pavements are more popular in the smaller places. It is usually more economical to build these types, and the time factor is not so important, nor is the aesthetic taste so highly developed. In the larger places we find the asphaltic types more popular. These types, when constructed by experienced contractors, give the most pleasing appearance, and are thrown open to traffic immediately after being laid. They also permit of easy repair, all of which means a distinct saving of time. Possibly one type of asphaltic pavement is as good as another if properly constructed. The probable reason that some well known types are so popular is that the companies laying them have had years of experience and maintain them rigidly.

Amount of Paving of Various Types

On June 1, 1920, there were 14,234,125 sq. yds. of pavement in use in Texas cities and towns.

30.5% of this was Bitulithic.
18.5% was brick.
12.4% was Asphaltic concrete.
8.2% was Portland cement concrete.
7.0% was Uvalde Rock Asphalt.

Costs of Pavements

Many people of today are wont to compare costs before 1916 with those of the past year and the present costs.

The circumstances governing costs before 1916 and those controlling the costs of the past year were so different that no direct relation could be said to exist. Outside of the bare comparison of prices for the same unit, further analyses and cross-comparisons are nearly impossible, because the circumstances governing the different units were so markedly different themselves.

These conditions with regard to transportation, labor, materials, equipment and living conditions are gradually approaching normal again. The approach to normal is not so perceptible, however, for some things and in some localities. Yet the general trend is in that direction.

High Freight Rates Greatly Delay Paving in Texas

The one great exception to such an assertion is that of freight rates. The high freight rates have greatly delayed pavement construction in Texas. The delayed paving work is directly traceable to them. During the past year freight rates on paving materials shipped to Wichita Falls have increased per ton as follows:

Rock	$0.90 to $1.20
Sand	1.10 to 1.50
Asphalt	5.15 to 7.00
Cement	3.60 to 4.90

Similar increases were felt in practically every city in Texas. The high freight rates have placed pavement construction in Texas, on the whole, at least one year behind the paving programs originally outlined.

On the other hand freight cars have become very plentiful. Shipping service is good. Delays to any great extent in transportation are no longer experienced. It is likely, of course, that the increase in freight rates has accounted for this plentiful supply of freight cars.

Labor has "about faced" from the independent attitude assumed a year ago, and now labor is more than plentiful. Wages have decreased, and the laborers themselves possess a higher morale, and work much harder for the lower wages.

Wages in Texas

About the first of June, when these data were prepared, wages for labor in various cities of Texas were as follows:

El Paso	$1.50 to $2.00
San Antonio	2.00 to 2.50
Beaumont	2.80
Galveston	4.00
Houston	2.80 to 4.00

Dallas 3.20
Ft. Worth 3.20
Wichita Falls ..... 3.20 to 4.00

Strong Demand for Paving Materials

The price of paving materials at the shipping points has decreased somewhat during the last six months. This decrease, however, was just about neutralized by the increase in freight rates. The demand for paving materials has been strong. While the relative amount of pavement construction in any one place may have been small, the vast road building programs inaugurated by the counties of Texas, in cooperation with the State Highway Department and the Federal Bureau of Public Roads, have made the total demand unusually great.

Texas Counties are Active

The counties of Texas alone have many millions of dollars at their disposal for good roads. Contracts to the extent of some twenty-three millions of dollars have already been let by the counties. In addition to this the cities of Texas propose to spend some six or seven millions of dollars this year for street pavements. Construction material will be in demand for several years, it seems, and the prices will depend upon labor, fuel, and the demand for the material.

Deliveries upon construction equipment are much better now than they were a year or so ago. Today rollers, excavators, graders and the like can be obtained from within two weeks to one month. Concrete mixers, especially certain types, are harder to obtain. Much of the equipment on the market today was manufactured by high priced labor and using high priced material. Prices of equipment will not decrease materially until the more costly manufactured equipment has been sold and that made by cheaper labor and containing cheaper material can be placed on the market. This will follow more quickly for some types than for others.

Living conditions have more closely approached normal in some places than they have in others. These living conditions are reflected in the prices paid for labor. Those places where living standards are more expensive must expect to pay more for labor, and, in turn, more for their pavements.

Factors Affecting Pavement Costs

Summing up the factors affecting pavement costs it is seen that:

1. Freight rates are still high.
2. Labor cost is decreasing as rapidly as living conditions will permit.
3. The demand for materials will have a tendency to keep the price of materials up and cheaper fuel and cheaper labor will reduce the cost of materials. Cities possessing local materials will, of course, be able to construct pavements cheaper than those that have no local materials.
4. Equipment becomes cheaper in just so far as that made by cheaper labor and containing cheaper materials is mar-

TABLE I—VARIATION OF PRICES OF PAVEMENTS IN TEXAS CITIES.

City	Type Pavement	Price Per Sq. Yd.	Curb or Curb and Gutter	Labor	Date of Letting
Fort Worth	2″ Bitulithic on 5″ concrete base	$3.55	$0.65 (curb)	$3.20	8- 8-21
Dallas	2″ Bitulithic on 5″ concrete base	3.95	1.40		6- 3-21
Paris	2″ Bitulithic on 5″ concrete base	4.12	1.60	2.80	4- 1-21
Paris	2″ Bitulithic on 7″ gravel & stone base (local)	2.95	1.70	2.40	4- 1-21
Waxahachie	2″ Bitulithic on 5″ concrete base	3.55	1.25		4-19-21
San Antonio	Concrete	3.15		2.00 to 2.50	5-26-21
San Antonio	Bitulithic on Macadam base	3.35		2.00 to 2.50	5-26-21
San Antonio	Uvalde Rock Asphalt Macadam base	2.80		2.00 to 2.50	5-26-21
Houston	2″ Bitulithic on 6″ concrete base	4.25		2.80 to 4.00	1- 8-21
El Paso	1½″ Bitulithic on 6″ stone base	2.28		1.50	5-19-21
Beaumont	2″ Asphalt on concrete base	8.73 per ft. for 22-ft. pavements		2.50	4-19-21
Wichita Falls	8″ reinforced concrete	3.73	0.65 (curb)	4.00	6- 6-21
Wichita Falls	2″ Bitulithic on 5″ concrete	4.23	1.50	4.00	6- 6-21
Wichita Falls	2″ Uvalde on broken stone base	3.87	1.35	4.00	6- 6-21
Wichita Falls	2″ Uvalde on concrete base	4.31	1.35	4.00	6- 6-21

keted. Since most experienced contractors possess a considerable amount of their equipment already, this will not affect present prices materially.

5. Living conditions and living standards affect the price of labor. The cost of pavements is cheaper where Mexican labor is plentiful since their living standards are lower.

6. Eliminating the differentials of local material, cheap labor and cheap living conditions, and living standards, then the prices of pavement in the different sections of Texas will vary but little.

Table I will give an idea of the variation in prices in the larger cities of Texas that have had recent pavement lettings.

Additional Cost Due to State Paving Law

There is still one thing that has not been mentioned with regard to pavement costs. That is the aditional cost entailed by the State Paving Law.

The present paving laws delay the paving of the streets materially. So many resolutions, ordinances, reports, and hearings are necessary, and the amount of time required for each step or procedure is so long that the total time required from the advertising for bids to the actual beginning of the construction is from two to three months. Even then something may creep in, or something be left out, so that uncertainties may develop.

It actually costs contractors more money to handle all of the required legal proceedings entailed by the State Paving Law. The extra time necessary means in many cases that their organization is tied up much longer than the time required to do the actual construction. The cost of possible lawsuits must be taken into consideration. Paving certificates must be carried from two to four years—and *all* of the property owners pay the cost.

At the last pavement letting in Wichita Falls the contractors were asked to state in their proposal the discount they would allow on complete cash payments. The discounts allowed by them ranged from zero to 10 per cent. This is an experiment on the part of the City of Wichita Falls. It remains for the future to tell whether or not it will be worth while. The people that can afford to pay cash are the ones that get the benefit of the discount. If the total contract cost of the pavement could be paid upon monthly and final estimates, the prices could be appreciably reduced.

Why Counties Get Better Prices Than Cities

As a general rule our counties pay the whole cost of road work in cash. A comparison of the contract prices that can be obtained by counties with the prices bid on city paving shows that the counties can get similar work done for considerably lower costs. The great difference against the cities is the overhead expense of the paving contractors doing city work. They must accept paper in payment for the bulk of their work. They must discount this paper through brokers, and at the present time the discount they must allow is relatively large. All of this the property owner must pay.

The Homestead Law

While we are revising things, let's not overlook the Homestead Law. This law makes it impossible to pave in front of a homestead unless the owner agrees to sign the necessary lien. Often property owners who can well afford to pave, refuse to do so, and leave an unsightly gap in the pavement which often causes the traveling public a great inconvenience.

The time has come when community rights must be considered. One person should not be allowed to make a whole community suffer. There should be some kind of a law that would force property owners to pave under certain conditions. This means a revision of the constitution. Texas is practicaly the only state in the Union, where, in the name of "Individual Rights" such stumbling blocks are placed in the path of Community Development. The need for such precautions are past. As long as the benefits to the property exceed the cost, then the improvement should be made, forcibly or otherwise.

The foregoing matter is from a paper presented by Mr. Montgomery before the latest annual meeting of the League of Texas Municipalities.

MAKING IRRIGATION BONDS SALEABLE

By John L. Hershey, of Hershey & Mirick, Consulting Engineers, Lincoln, Neb.

For some years past, irrigation securities have been in disrepute with the investing public, and possibly there has been good reason for much of the feeling against them. However, if there is to be irrigation development, other than the regular government reclamation projects, something must be done to give legitimate bond issues for irrigation development the standing they should have among investment securities.

There are still many good projects which should be developed in order to increase the producing and taxable value of many thousand acres of western land. In order to do this, bond issues against the land will have to be floated, and until there is some means for the investing public to distinguish the sheep from the goats, and for relieving the general suspicion against all issues, however valuable they may be, little can be accomplished.

Just at this time the market value of land in general is too low on account of the reflex action due to over-valuation during the war period and the two years immediately succeeding it. Conditions must soon begin to improve, however, and as soon as the foreign markets open up and a certain amount of desirable readjustment takes place, interest in farm lands and their full development will revive.

Drainage in many parts of the United States, and irrigation in the arid and semi-arid West are two great contributing factors in increasing production, and by so doing, increasing both marketable and taxable values. Drainage, probably on account of its more general distribution and the better laws governing its development, seems to be in better shape than irrigation. Drainage district bond issues certainly have a more ready sale than district irrigation issues, though it must be admitted that 87½ per cent or 90 per cent is altogether too great a discount for either. The writer understands that the above discounts are about the average for those issues which can be disposed of.

Schemes That Failed

There was a period between 1906 and 1913 when a large number of privately-financed irrigation schemes were put through, and it is a well-known fact that many were poorly conceived, poorly financed, and we must admit it, the engineers were often too optimistic. Districts were formed during this period with insufficient water for the land under development, and the total cost of promotion, financing and construction put a tax of from $50 to $100 or more per acre on raw, undeveloped land, the expectation being that its value would immediately increase to $300 or $500 per acre. The cold facts are that some of these propositions were almost worthless and the payments on bond issues defaulted. Even on some, in which the ultimate value was considerably more than the bonded indebtedness, interest payments lapsed and the bonds were so scattered that judgment against the property in the courts was impossible to obtain from lack of concerted action.

To guard against the above condition, some of the far-western states have put the official stamp of approval on district bond issues, making them a legal investment for trust funds, banks, and insurance companies.

The California Law

The California law, on which at least two other states have based similar statutes, places the legalizing of any irrigation bond issue in the hands of a commission made up of the attorney general, state engineer and the superintendent of banks. A bond issue first requires a vote of four-fifths of the qualified electors of the district, after which the commission reports on the water supply, nature of soil, feasibility of irrigation system or contemplated work, reasonable market value of water rights, reasonable value of lands, and on whether the amount is less than 60 per cent of the market value of water rights and lands. After the commission has acted favorably upon an issue, the bonds become a legal investment as above stated, being listed fourth in the desirable issues for the investment of mortgage insurance company's capital.

Oregon and Idaho Laws

Oregon has a very similar law, its commission is made up in the same way and the bonds are a legal investment for all trust funds, funds of insurance companies, banks and trust companies.

In Idaho, the district irrigation bonds, after being passed upon, also become a legal investment for insurance companies, trust companies and savings banks. In this state these bonds are third in the list of desirable investments, being classed with city, town, county and school district bonds.

The Nebraska Law

In Nebraska, the law governing the formation and working of an Irrigation District seems comprehensive and complete except that it does not require sufficient financial investigation and the approval of some authoritative state board other than that of the Department of Public Works, which passes only on the physical features of the project. Under the existing laws bonds may be issued against the district for buying water rights, canals and reservoirs, or for the construction of new works, and if the bonds can be given a perfect legal history, if the water supply is sufficient and

the construction plans adequate, no further restriction is placed upon them.

District bonds in Nebraska run for 20 years, draw interest only for the first 10 years and pay gradually increasing sums during the 10 to 20-year period. Interest and principal are payable as taxes, and as the bonds are a first lien on the land, it may be sold for the non-payment of interest or principal. It would seem, therefore, that there should be no trouble in making collections, especially if the land is well developed and producing good crops, so that the main thing for the investor to consider is the value of the property and the total amount of bonded indebtedness.

Illustration of Difficulty of Selling Bonds

Just how difficult it is to dispose of irrigation bonds is well illustrated by the experience of one of the oldest and best-established districts in the state of Nebraska. This district comprises 10,000 acres of well-improved and highly-developed land with a good water right and distributing system. The water rights and canal system cost the district $150,000, for which it issued bonds which are now in their tenth year. Interest payments have always been met promptly and the district is in a good financial condition. In order to increase its water supply so that there will be no failure of water at any time, and to extend its boundaries 3,000 or 4,000 acres, the district has voted a $125,000 issue, which would bring the total bonded indebtedness up to $275,000, or $27.50 per acre. Now, though the land has increased in value from $70 per acre at the time of the first bond issue to from $125 to $175 per acre, and would be worth from $25 to $50 more after the new development, it has been impossible for the district to interest the bond buyers enough even to talk seriously of floating the issue.

The above illustration is given merely to show the feeling against irrigation bonds in general in the central West, as this particular proposition is so obviously a good risk that it should be snapped up on its merits.

It seems to the writer that such a condition is worth the serious consideration of all those interested in irrigation development. It may be that more or less uniform laws following those of California, Oregon and Idaho, giving worth-while bond issues of irrigation districts a legal status by action of a well-balanced committee of state officials, would have the desired effect and give them a good financial standing.

REFUSE DISPOSAL BY INCINERATION IN INSTITUTIONAL AND INDUSTRIAL BUILDINGS

By William F. Morse, Consulting Sanitary Engineer, 1007½ Kee Mar Park, Cleveland, Ohio.

A recent technical work on the subject of refuse is devoted almost exclusively to the collection and disposal of municipal refuse, and but little reference is made by the authors to the methods and apparatus used by the great public institutions, railroad terminals, markets, hospitals, private industrial establishments, medical schools and colleges, U. S. Government posts, and many other places where incineration is employed as a means of waste disposal. Yet, taken altogether, the number of these smaller installations is far greater than that of the municipal disposal plants, and in the aggregate the daily quantities dealt with will nearly equal the amounts handled by the civic plants.

The usefulness of these minor installations is established beyond question. In some cases they are used by municipalities in their larger institutions, but a far greater number are installed by private enterprise for the disposal of worthless matter produced on the premises, which is troublesome to deal with in any other way than complete destruction.

Disposal of Market House Wastes

For the disposal of the waste of market-houses there is no method so satisfactory as incineration on the premises. Given a market containing from 100 to 150 stalls, handling every variety of food products, there is a daily accumulation of refuse material of from 10 to 15 cu. yds., weighing approximately 3 to 5 tons, according to seasonal conditions. If this is hauled to a dump by truck or wagon the daily cost is a considerable item in the administration expense. A small percentage of the waste—the meat cuttings, fat and bones—have value, but the greater volume of miscellaneous rubbish, which consists of animal, fish and vegetable refuse, paper, wood and metal, paper containers, floor sweepings and contaminated matter of every description, must daily be removed or destroyed, and this disposal must be in accordance with the sanitary laws, and without nuisance or offence to persons or property.

The Incinerator

The apparatus for incineration is not complex in design; it can be built from detailed working drawings by a compe-

tent bricklayer who can read plans and follow clearly printed instructions. The design may be varied to conform to the architect's plans, or to suit a limited floor space, or chimney or boiler flue connection, but the floor space for the Incinerator must not be less than 8 ft. by 6 ft., with room on side or end for stoking and removal of ashes.

Upon receipt of preliminary information each Incinerator is specially designed for the required location. Usually this is the basement or cellar floor, and the Incinerator is connected with the main chimney of the heating plant, or with the boiler smoke flue; or, if the location be outside the building, there is provided a brick chimney or steel stack with firebrick lining, rising above the top of the market building, or higher if this is necessitated by the height of the surrounding buildings.

The fire-box, floored with heavy castiron grates, is charged from the main floor of the building through a chute covered by a fire-clay slab enclosed in a castiron rotating frame. The interior walls, roof and connecting flue are of the best quality of firebrick, and the whole construction is braced and stayed by vertical and horizontal steel beams and angles. No iron is exposed to the flame except the face of the castiron lining of the stoking door. The consuming heat may be raised to the highest temperature and maintained indefinitely without injury to the furnace. The design may be varied to charge from the side or from the end, to suit local conditions.

Construction and Operation of One Market House Incinerator

The continuous observation for three years of an Incinerator placed outside a market house containing 150 stalls, with a separate steel stack of 75 ft., may be taken as an example in construction and operation. Early in the morning the fireman in charge gives his assistance in collecting the refuse, and this is brought to the incinerator, which has previously been thoroughly cleaned of ashes, clinkers, iron, wire, glass and all other incombustible matter, usually about one barrow load. The largest tins are thrown out, as these interfere with the firing. The furnace is then charged with 3 cu. yds. of mixed refuse. Frequently a barrel filled with vegetable matter is dropped through the charging-port to the fire-bars below. No other fuel is required or has ever been used during the whole period of operation of this furnace. Combustion proceeds in the natural way, that is, by burning from the bottom, not from the top. This is done in the furnace itself; the smoke, gases and fumes pass through flues into the combustion chamber, where is completed the final transformation into CO_2. During the charging period of one minute the down draft through the chute prevents the emission of smoke or fumes of combustion.

The practical results of this installation are the destruction of all mixed market waste without the use of fuel other than the material burned, the intermittent labor of one man only, and the disposal of worthless matter in a sanitary way, without nuisance, at an extremely low cost.

The initial expense of the installation is very moderate when compared with the benefits that follow the adoption of this method.

In larger public or private plants or buildings, where the amount of waste is large, and it is costly to remove it, installation of an incinerator solves the problem in a thoroughly satisfactory way.

Incinerators at Railway Terminals

In the great Hudson Terminal Building, New York City, which has 5,000 daily occupants and a connecting underground railway, there is installed an incinerator designed and built by the writer in 1907. This furnace has been in continuous operation for 15 years. The conditions in this building required a furnace with the capacity of 10 tons to receive the daily garbage, combustible refuse, floor sweepings from the rooms and corridors cleaned by the vacuum process, and the refuse from the railway used by thousands of travelers. All the conditions were successfully met, and the superintendent of the building in recent conversation with the writer remarked, "I could not do without the incinerator."

In a similar way, the enormous volume of refuse from the multitude of industrial plants housed in the Bush Terminal Building at South Brooklyn, N. Y., is transformed into steam by the aid of two large incinerators which use no other fuel, and operate two 350 h. p. steam boilers, saving an equivalent amount of coal.

Other terminal and way stations on the Pennsylvania, Reading and Baltimore & Ohio Railways, in New York, Philadelphia, Baltimore, Washington, and other cities of the south and west, use this form of disposal for every kind of refuse.

The U. S. Government was among the first to recognize the value of this means

Hinsdale-Downers Grove Road, Downers Grove, Ill. "Tarvia-X," 1920

What did the Winter do to Your Roads?

In communities where the annual Spring thaw turns roads into mires of soggy mud, Spring is a season of discomfort and isolation.

Throughout the country, there are still thousands of such communities. Perhaps yours is one of them. Perhaps the picture at the top of the page is typical of some roads in your locality.

Now look at the Tarvia Road shown at the right. This road is waterproof and frost-proof. Neither the freezes of Winter nor the thaws of Spring have any effect upon it. This highway is firm, smooth, dustless and mudless all the year round.

Your community—*any community*—can afford such roads. They are comparatively low in first cost, and are so much more economical over a term of years that the saving makes a more extensive road program possible. In many cases the old macadam or gravel can be utilized as the foundation for a traffic-proof Tarvia top.

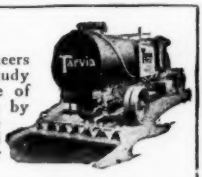
We would like to tell you more about the many uses of Tarvia, its ease of application and its economy as a maintenance material for hard-surfaced roads and pavements of every type. A letter addressed to our nearest office will bring you facts, figures and pictures.

No highway engineer or road official should be without a copy of our latest manual, "Road Maintenance with Tarvia." Our nearest office will gladly send free copy upon request.

Tarvia
For Road Construction Repair and Maintenance

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.



New York, Detroit, Peoria, Youngstown, Baltimore, Chicago, New Orleans, Atlanta, Colorado, Omaha, Philadelphia, Birmingham, Duluth, Columbus, Jacksonville, Boston, Kansas City, Milwaukee, Richmond, Houston

The Barrett Company

St. Louis, Minneapolis, Bangor, Latrobe, Denver, Cleveland, Dallas, Washington, Bethlehem, Cincinnati, Syracuse, Johnstown, Elizabeth, Pittsburgh, Salt Lake City, Lebanon, Buffalo

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S.

of waste treatment. The first permanent installation for an army post was designed by the writer in 1894, and is *still in use*. Space will not permit more than a passing reference to installations in four Navy Yards and very many others in Army Posts built by the writer, all of which are in active service.

There is hardly any form of refuge that fire will not affect; and there is no combustible matter that cannot be destroyed in a properly designed and efficiently operated incinerating furnace. Moreover, the work can be done in strict compliance with the regulations of the municipal authorities, and with practical, economical results that no other method can equal.

SOLVING A TYPICAL ROAD PROBLEM IN THE SWAMP LANDS OF ARKANSAS

By B. H. Klyce, Civil Engineer, 720 Fourth and First National Bank Bldg., Nashville, Tenn.

Given two thriving towns twelve miles apart connected by a dirt road across a very poorly drained country, much of it swampy, but very productive when properly and completely drained: Problem—To build a road which will be serviceable the year round. Such was the problem in Craighead County, Arkansas, for the two towns of Nettleton and Lake City.

The country in this locality slopes gently in a generally southerly direction with a slope of about 1 ft. to the mile, while the proposed road was to run east and west. There were four drainage ditches crossing the road at right angles.

There were numerous but relatively short stretches of gumbo with its characteristic quality of absorbing water very readily and then retaining it tenaciously; a very small amount of water is sufficient to render a section of gumbo road impassable for long periods of time.

There were no road surfacing materials locally available. Funds were limited as usual.

Under these conditions it was deemed necessary to raise the road above the general level of the land, to build a dike in fact. Drainage ditches with from 3 to 12 ft. of bottom width and varying in depth from 3 to 8 ft. were excavated alongside the roadway.

Since there was no outlet for these roadside ditches except for the above mentioned intersecting main drainage ditches and which were located from one to five miles apart, it was necessary to carry the water alongside the road for long distances. This road is consequently distinguished by the almost total absence of culverts. There is little erosion, however, because of the low velocity of the water.

For practically all of the excavation, dry land dredges of the walking type were used; these dredges straddled the ditches and deposited excavated material in the roadway, where it was later leveled with a road grader pulled by "caterpillar" tractor.

The road right of way was from 60 to 80 ft. in width. The roadway fill was planned with a minimum top width of 28 ft. ,allowing 18 ft. of pavement with 5-ft. shoulders.

Most of the excavation was completed a year in advance of construction of the paving, thereby allowing the rains and traffic to settle the fills as much as possible.

All sections of the road composed of gumbo were covered with several inches of sand or sandy loam, such as was locally available; traffic was allowed to incorporate the sand in the gumbo. This treatment was found quite effective in taming this bete-noir of the road engineer, greatly improving such sections and rendering passable roads which had formerly become impassable with every shower.

Water-bound macadam to a width of 18 ft. and with a bituminous surface treatment was adopted as the paving material. It is intended after a few years when thorough settlement has taken place to use the macadam as a foundation and place on it a higher class wearing surface.

The above features of road construction in low lying or swamp land are not new, but it was thought they might be of some interest to our brother engineers in the highlands.

Payne Dean Limited, 103 Park Avenue, New York City, manufacturer of Dean Control for electrical operation of water, gas and high pressure steam valves, has established offices in Pittsburgh and Chicago. Mr. C. J. Burrage, late Captain of the A. E. F., and formerly of the Engineering Department of the Cutler-Hammer Mfg. Co., is in charge of the Pittsburgh office in the Bessemer Bldg. Mr. A. H. Kohlbusch, late Superintendent of Construction for the Public Service Electric Co., has been placed in charge of the Chicago office in the Lumber Exchange Bldg., 11 S. LaSalle Street.

WATER WORKS SECTION

METHODS AND COSTS OF BUILDING 10 MILLOIN GALLON, REINFORCED CONCRETE RESERVOIR FOR THE INDIANAPOLIS WATER CO.

By William Curtis Mabee, Assistant Chief Engineer, Indianapolis Water Co., Indianapolis, Ind.

The Indianapolis Water Company built and placed in service in 1921-1922 a 10,000,000-gal. reinforced concrete, covered reservoir, complete with pipe connections and appurtenances, but excluding engineering, at a total cost of $223,500.

The site chosen for the new reservoir was formerly part of the open infiltration gallery at the Riverside Pumping Station, constructed in 1882 and abandoned as a source of supply in 1907 when the first covered reservoir at this station was built.

Depth

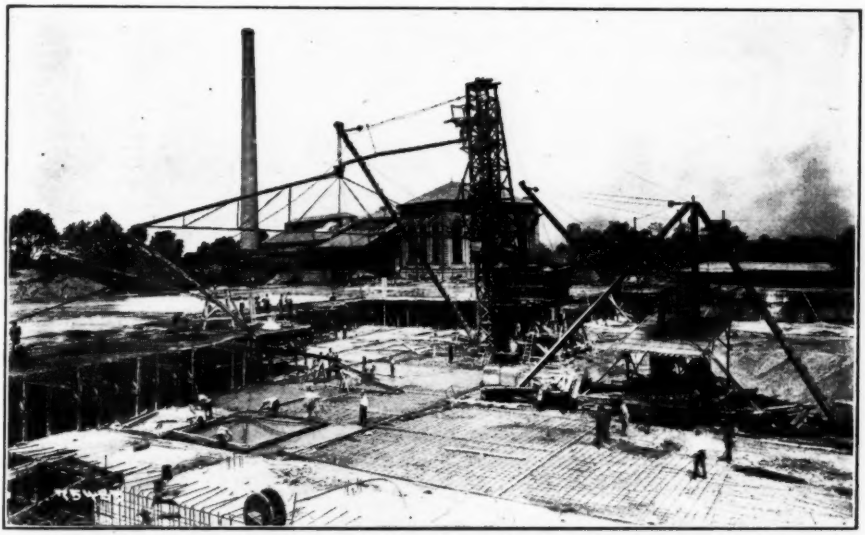
In determining the depth of water to be stored in the new reservoir it was necessary to consider the hydraulic gradient of the supply conduit which discharges filtered water at this station, as affecting the upper limit of elevation of water stored and a further consideration of the ground water level at this station as the lower limit, keeping in mind the danger of rupture from rising ground water levels. The depth of water stored, 10 ft., and 3 ins., was therefore fixed by these limitations.

It was considered advisable and necessary so to design the reservoir that a rise in the ground water level of 10 ft. would be counterbalanced by the weight of the structure and the superimposed loading of earth upon the roof of the structure without consideration of the weight of the water contained within the reservoir.

Groined Arch Floor

This excessive upward pressure of ground water during flood stages, calculated to be exerted at a time when the reservoir might be empty, and the necessity of an equal distribution of downward pressures upon the soil presented a problem in the design of the floor which obviously could best be solved by the employment of the groined-arch type of floor construction.

It may also be noted that the groined-arch floor forming intersecting valleys



VIEW SHOWING VARIOUS STAGES IN THE CONSTRUCTION OF THE 10 MILLION GALLON, REINFORCED CONCRETE RESERVOIR OF THE INDIANAPOLIS WATER CO.

can be the more readily flushed when necessary to clean.

Flat Slab Roof

While a groined arch roof would have been as satisfactory as the flat slab type of construction adopted, experience here as elsewhere has shown that contractors as a rule prefer to build along lines with which they are familiar and will for that reason submit lower prices for the flat slab type of construction than for the groined-arch type, notwithstanding the groined-arch roof requires practically no steel.

Earth Covering

The necessity of weighting the structure suggested the use of 27 ins. of filling on the cover ,assumed to weigh when saturated 250 lbs. to the square foot. This fill also prevents the formation of ice in the reservoir and tends to maintain the roof slab at a reasonably uniform temperature in all seasons ,thereby minimizing the distortion of the structure from temperature changes.

Loading

The total live and dead load considered upon the roof slab was 470 lbs. per square foot or a superimposed load of 350 lbs. per square foot.

Having determined the type of structure to be constructed and the loading to be supported, the question of column spacing was next considered.

Column Spacing

The usual spacing for work of this character varies from 15 to 25 ft. and for the loading under consideration the slab thickness would vary from 7½ ins. for the 15-ft. spacing to 12 ins. for the 25-ft. spacing; the column spacing could even be made as little as 10 or 12 ft. centers. There is no doubt in the writers' mind that the structure with the smaller column spacing can be built for less money; but considering the ground water problem and the desirability of heavy sections lending their weight, strength and dependability to the structure in addition to the degree of impermeability required in a structure of this character, the column spacing that would satisfy these requirements was determined to be 18-ft. centers.

The first slab is designed in accordance with computations based upon the rulings of the American Concrete Institute for four-way reinforcement. Columns are 24 ins. diameter, spaced 18 ft. center, each reinforced with eight ⅝-in. round bars and ¼-in. tie bars.

The reservoir is rectangular with rounded corners, inside dimensions 254 ft. wide, 542 ft. long and 10 ft. 8½ ins. deep, with a storage capacity of approximately 1,000,000 gals. per foot depth.

Data on Costs and Prices

The net area for water-surface-is 136,500 sq. ft., or 3⅛ acres, and the cost per million gallons stored exclusive of piping connections, brick baffle walls and engineering, but including all earth work was $19,150, equivalent to $1.41½ per sq. ft. of water surface.

Expressed in percentage this cost was divided as follows:

Excavation, average cut 11-ft.	15.6%
Refill, 27-ins. deep on cover	7.1%
Levee Embankments	2.0%
Concrete Structure including sub-grading	75.3%

The typical labor charges upon which these costs were based were:

Common Labor	30 cts. per hour
Skilled Labor	35 to 60 cts. per hour
Form Builders	60 cts. per hour
Teams	75 cts. per hour

All levee work was done by force account for which the company allowed the contractor cost plus 15%.

Quantities Involved

Earthwork—80,319 cu. yds. of which 52,175 cu. yds. were excavation from reservoir site placed into embankments and spoil banks and 28,135 cu. yds. refill over and around structure and in shaping levees.
Concrete—11,158 cu. yds.
Cement—15,523 barrels.
Steel Bars—464 tons.

Plans and specifications for the work were prepared and the work divided into two parts; (1) Excavation, and (2) Concrete work including Refill.

Excavation

Bids were received for the excavation work Feb. 15, 1921, from six local contractors as follows:

	Per cu. Yd.
American Construction Co.	$1.10
Timberlake Construction Co.	0.88
Sheehan Construction Co.	0.90
Mansfield Engineering Co.	0.738
Harold & Butner	0.90
R. H. Scott & Co.	0.56

The contract was awarded the lowest bidder, R. H. Scott & Co., Feb. 26, 1921; the unit price of 56 cts. per cu. yd. included all clearing and grubbing of trees and the segregation of the loam, sand and gravel into separate piles, the earth and rejected gravel going into embankments and levees.

This work was completed and final payment made Aug. 6, 1921; elapsed time 5 months 11 days. Quantity of material handled: 52,175 cu. yds., including 10,000 cu. yds. of sand and gravel which was washed and screened from the excavation

for concrete work under a supplementary contract.

The dimensions of the excavation were 280x570 ft.; area 3 2-3 acres, with a cut varying from zero to 23½ ft., the average being 11 ft. The character of excavation was top soil and bank gravel, the work contemplated filling an abandoned infiltration gallery or reservoir which extended diagonally across the site for the proposed new structure with sand and gravel from the excavation and rolling the fill with a locomotive crane, the expense of rolling being paid for on force account.

Gravel which was suitable for concrete was washed and screened and stored in piles upon the old infiltration gallery site at an additional cost of 40 cts. per cu. yd. The top soil was carefully selected and stored in piles conveniently located for top dressing the embankment after the completion of the structure.

Excavation progressed at the following rates: First month 21%, second month 42%, third month 15%, fourth month 14%, fifth month 8%.

The equipment consisted of a locomotive crane operating a yard and a half clam bucket which was used to fill the old gallery and which was also used to elevate gravel to the washing platform. The larger part of the excavation was handled by teams and wheeled scrapers.

The average rate of excavation for elapsed time was 324 cu. yds. per day and the maximum rate for 30 days was 750 cu. yds. per day.

Earth Refill and Embankment was included in the contract for concrete work and was handled by wheeled scrapers as follows:

17,985 cu. yds. at 55 cts. per cu. yd.
10,150 cu. yds. by force account cost 75 cts. per cu. yd.

Total excavation and refill, 80,310 cu. yds. at an average cost to the Water Company of 58 cts. per cu. yd.

The average rate of embankments for elapsed time was 230 cu. yds. per day and the maximum rate for any month was 293 cu. yds. per day.

Concrete Work

Eleven bids were received for placing 11,158 cu. yds. of concrete, the Water Company furnishing all cement and steel to the contractor on board cars at Water Company's switch and also delivering gravel to the site, the contractor unloading, hauling and storing cement and steel, furnishing all material for forms, centers and supports; bending, setting and securing all reinforcing bars, mixing and placing concrete and fine grading and tamping the bottom of the reservoir. The bids follow:

	Per cu. yd.
Henry Mang	$15.08
W. P. Jungclaus Co.	13.50
Hoffman Construction Co.	11.50
Warner Construction Co.	11.00
J. G. Karstedt	10.00
Hall Construction Co.	8.72
Dodge & Heiby	7.82
J. W. Martin	7.77
R. H. Scott	6.90
Bunting Construction Co.	6.75
Mead Construction Co.	6.35

The contract was awarded the Mead Construction Co., the lowest bidder, May 26, 1921, and was finished Oct. 24, 1921, the day before the time set in the contract for completion. The placing of concrete began June 27th and was completed in 120 days elapsed time. Average daily progress for elapsed time (120 days), 93 cu. yds. Maximum day, 328 cu. yds. Average monthly progress, 2,800 cu. yds. Maximum month, 5,323 cu. yds. Expressed in percentage the rate of progress follows: June 2%, July 25%, August 48%, September 21%, October 4%; total 11,158 cu. yds.

The Water Company furnished 15,523 barrels of cement at a cost of $2.44 per barrel, which the contractor handled for 19 cts. per barrel; 464 tons of steel bars cost the Water Company $2.58 per 100 lbs., including the cost of bar spacers and was placed for $15 a ton; 5,505 cu. yds. of gravel were purchased at a cost of $1.53 per cu. yd. and 8,443 cu. yds. of gravel were reclaimed from the excavation at a cost of 47½ cts. per cu. yd.

Concrete Costs and Quantities

The concrete was mixed 1:2:4 and required 1.39 barrels of cement, 83 lbs. of steel and 1.25 cu. yds. of gravel. The unit cost of concrete to the Water Company, excluding engineering, follows:

Cement	$3.40 per cu. yd.
Steel Bars	2.15 per cu. yd.
Gravel	1.11 per cu. yd.
*Labor (by contract)	6.39 per cu. yd.
Total	$13.05

* Including a small quantity at $8.00.

Quantities of concrete in

Floors	5,479 cu. yds.	49%
Walls	861 cu. yds.	8%
Columns	366 cu. yds.	3%
Roof	4,345 cu. yds.	39%
Miscellaneous	107 cu. yds.	1%
Total	11,158 cu. yds.	100%

The labor cost of mixing and placing was $1.71 1-3, fuel 12 cts. and miscellaneous hardware, steel and repairs 29 cts. per cu. yd.

Reinforcing Steel

The distribution of steel bars was as follows:

Floor...	124 tons	—0.34% by volume of concrete
Walls..	47 tons	—0.83% by volume of concrete
Col'ns..	31 tons	—1.28% by volume of concrete
Roof...	255 tons	—0.89% by volume of concrete
Misc...	7 tons	—0.94% by volume of concrete
Total.	464 tons	—0.63% by volume of concrete

placed at a cost of $15 per ton.

Hand grading and tamping preparatory to laying floor cost the contractor $1.50 per 100 sq. ft.

Constructing the Floor Arches

The floor is formed by a series of parabolic groined arches having a rise of 18 ins. on a span of 15 ft. 8 ins., a minimum thickness of 9 ins. and a maximum thickness of 27 ins. at the columns. The column base is 28 ins. square. In construction the floor was divided into two parts; the lower 4 ins. was laid first as a mat, reinforced with ½-in. square twisted bars spaced 12 ins. centers in two directions; this mat served the double purpose of a waterproof membrane and as the foundation for the groined-arch upper floor section.

In forming the parabolic floor section unit metal frames were employed whose arrises were made of heavy steel tees supported upon rectangular wooden frames. Eight of these frames were made, each being used over 50 times. The concrete was troweled smooth by working cement to the surface.

The cost of setting the floor screeds 420 times was $1.02½ each.

Contractor's superintendence, field-office and bond expense are not included in unit costs quoted, but they do include whatever profits were realized by the contractor.

The Roof Slab

The roof slab is 9 ins. thick, having drop panels at the column heads 6 ft. 6 in. square extending 5½ ins. below the bottom of the slab. The reinforcement was from billet stock rolled into deformed bars and stressed under the assumed leading to 16,000 lbs. per square inch.

The columns and column heads are circular and were formed by special metal forms rented by the contractor.

Columns and Walls

The cost of setting the 420 column forms was $2.03½ each; the rental of column forms sufficient to form 10 per cent of the columns at once and the purchase of floor screeds distributed over 420 columns amounted to $6.32 each.

The walls are 15 ins. thick and rest upon a footing 9 ins. thick extending 12 ins. outside of outer wall line, the vertical reinforcement having its anchorage in the floor and roof slabs. The walls at the corners of the reservoir are curved to a radius of 10 ft., this expedient having been found successful in the elimination of contraction cracks at points where such cracks are usually found troublesome.

Reinforcement for temperature stresses in the walls consisted of ⅝-in. round deformed bars spaced 12 ins. centers in each face.

Forms

The form lumber necessary to construct 18 per cent of the wall length and 15 per cent of the roof surface including supports for 27 per cent of the roof surface distributed over the entire surface formed amounted to 5 cts. per sq. ft. The cost of forming labor for roof surface was 11½ cts. per sq. ft. and the cost of wall surface 5 7/16 cts. per sq. ft.

The roof forms consisted of a series of bents or trussed units made from 2x8-in. planks doubled which were spaced 3½ ft. centers and lagged with 2x8-in. planks. These bents were erected upon wedges. At the center point of each panel between columns a 4x6-in. prop was left standing for 7 days after the centers had been struck. The drop panels around columns were made of wooden units in two sections and were used about 7 times.

Wall forms were made in unit sections each 4 ft. wide using ⅞-in. tongue and groove sheathing placed vertically, reinforced by 2x6-in. ribs placed logitudinally and with wood flanges at the sides for belting the sections together; 4x6-in. horizontal walings spaced 24 in. centers were bolted through the wall at intervals of 30 ins. by ⅜-in. round rods held by set screw clamps; these rods were left in place after the removal of forms and the ends burned off flush with the wall and plastered with pitch.

Construction Equipment

The contractor's equipment consisted of one 18 cu. ft. Koehring Mixer mounted upon a platform forming the base of a tower 74 ft .high and located beneath a charging hopper or bin holding 45 cu. yds. of gravel, the tower supporting one concrete chute 30 ft. long and two counterbalanced chutes, one 40 ft. and one 50 ft. long, giving a working radius of 120 ft. This apparatus was mounted upon rollers for convenience in moving. The chute system was manipulated from a 70-ft. boom attached to the base of the tower and the elevating bucket operated by a Byers single drum hoisting engine. The

hopper was charged by means of a Clyde 2-drum hoisting engine mounted upon a stiff leg derrick mounted upon rollers and having a 70-ft. boom and ¾-yard clam bucket.

In addition to this outfit the contractor used a Jaeger ½-sack batch mixer for placing floor concrete.

Construction Methods

The larger mixing plant was first placed in the center of one end of the structure and was moved eight times down the center to the opposite end, finishing floor, walls and roof as the derricks were moved along. Day-joints were properly bulkheaded and keyways left in all bulkheads. Immediately upon the completion of one portion of the roof the margins of the day's work were dammed with a small mortar edging and water about 1½ ins. deep was permitted to fill the enclosure; this procedure resulted in eliminating surface checks by keeping the fresh concrete saturated and also tended to keep the temperature of the concrete from rising during the hot days of mid-summer. No expansion joints were provided, dependence being placed upon the steel bars, keyways and the density of the concrete mixture to produce a monolithic and waterproof structure. The centers were removed seven days after pouring a section of roof slab leaving, however, one 4x6-in. prop in the center of each span between columns in two directions. In seven days more these props were removed and in two more weeks, or 30 days from date of pouring, the earth fill was distributed over the roof in layers 7 to 10 ins. deep. It must be borne in mind in this connection that the work was practically done in midsummer when weather conditions for curing the concrete were most favorable.

The roof surface was smoothed with wood floats. Bar spacers to properly align and space the reinforcing bars were employed throughout using metal high chairs at the column heads to maintain the steel in its proper position. Eight manholes and four ventiators are provided for ready access and ventilation.

The reservoir is divided into three passes by two baffle walls which provide for the uniform circulation of water through all parts of the basin; they are constructed of 4-in. brick walls joining columns and extend to the column heads, the walls being reinforced at the middle point of each panel by a 12-in. square brick column; 60,000 bricks were used in these walls.

Piping connections are provided so that water may enter or leave the reservoir at three points. One of these connections communicates with an adjoining reservoir of less capacity through a controlling chamber having a drain connection by means of which either reservoir may be emptied and cleaned independently. Another of these connections enters a sump or suction well making practically the entire contents of the reservoir available to the pumps. Pine connections are 48-in. diameter.

The structure is an excellent example of good workmanship in concrete and the Water Company has every reason to be gratified by the able and efficient manner in which the work was handled by the contractors.

Piping connections were completed and the reservoir tested and placed in service in January, 1922.

Acknowledgment is made to the Mead Construction Co., Indianapolis, for the cost data furnished; to B. J. T. Jeup, Chief Engineer, Indianapolis Water Company, under whose direction the work was executed, and to Leonard Metcalf, Consulting Engineer, Boston, for helpful suggestions.

The foregoing paper was presented by Mr. Mabee before the annual convention of the Indiana Sanitary and Water Supply Association, held in Indianapolis, March 22 and 23, 1922.

DISCUSSION OF THE CENTRALIZED SOFTENING OF A PUBLIC WATER SUPPLY

(Editor's Note:—The following letter from Mr. George A. Johnson is supplementary to the Symposium on the Centralized Softening of a Public Water Supply, published on pages 103-108 of the March, 1922, issue of Municipal and County Engineering.)

To the Editor:

Relative to water softening, I may say that I have some very pronounced views on that subject, coming from rather intimate contact with a number of problems involving correction of chemical imperfections of water. Replying to your questions seriatim:

1. I do, unqualifiedly, consider it economically feasible to soften an entire public water supply at a central point before it is distributed to the consumers; and that it is vastly more economical in the case of the average water taker to proceed in this manner than to attempt such

softening on the premises of the individual householder.

2. With regard to whether the above may be made to apply to the industrial as well as to the domestic consumer, I am of the opinion that it most assuredly can.

3. I do believe that centralized water softening is economically feasible.

In more detailed explanation of the foregoing expressions I would point out that water softening is a real art, requiring primarily a clear understanding of the conditions to be met, knowledge of the principles involved in the proper corrective process, proper design of the softening works, and, finally and most important of all, competent and faithful performance on the part of the operating staff. In addition to all these, and particularly in cases wherein the corrective process lime and soda are employed, adequate appropriations must be made, and continue to be made, for the purchase of such supplies.

Paradoxically enough, municipal water softening, while economical in the end, is a relatively expensive undertaking. If the process involves the use of lime and soda its cost is proportional to the hardness of the raw water. In a lesser measure the same thing is true where softening is effected by the use of zeolites, true or artificial. The obvious thing to do is first to educate the public in the benefits which will follow the softening of its water supply to a given definite point, and then make suitable financial provision in the annual budget so that the ideal thus set will in the future be always realized. Once give a community formerly accustomed to a very hard water a water supply possessing a 100-part hardness, and thereafter attempt to exercise economy in the use of softening chemicals resulting in a water of 125 parts hardness and the uproar of protest will be immediate.

There are two practical methods of reducing the natural hardness of a public water supply. One is by the addition to such water of lime to remove calcium and magnesium carbonates, and soda for the removal of the sulphates, chlorides or nitrates of lime and magnesium. Furthermore, in this process it does not seem feasible or possible to completely soften a water, but that some 35 parts per million of alkalinity will remain after complete lime treatment has been employed; and as regards the reduction of the sulphate hardness the necessary use of soda, which constitutes one of the chief items of expense in softening a selenitic water, makes it advisable to restrict such softening to the limit indicated by the benefits to be derived from it.

In the lime and soda process, perhaps best exemplified in the water works at Columbus, Ohio, the chief difficulty lies in always getting a uniform application of the correcting chemicals to the raw water. Cold temperatures slow up the softening reactions, and certain mechanical features of operation must be adjusted with a considerable degree of nicety in order always to obtain the desired results. Residual causticity, always a highly undesirable and frequently troublesome factor springing from chemical overdosing, low water temperatures, inadequate mixing and agitation, etc., is one of the objectionable features of the lime and soda process, and is a potential possibility in proportion to the completeness with which water softening is attempted.

This softening process must always be followed by sedimentation, and usually by filtration as well. It is not economical to forego a suitable period of sedimentation prior to filtration for the reason that one essential of the process is to maintain in suspension the precipitating salts (hardness) during the softening period. To apply such water to filters direct would result in their speedy clogging. Usually before filtration a sedimentation period of several hours is required in order effectively to guard against incomplete softening in the reaction period, to overcome uncertain factors introduced by cold weather conditions specifically as regards retardation of the softening action, and the undesirable effect produced by possible after-reactions. These relate to the very undesirable feature so often noted of the deposition of slow-forming precipitates upon valves, boiler water condensers, in service pipes, etc.

By and large, however, the lime and soda process, in a system properly conceived, designed, built and competently operated, and when followed by a suitable period of sedimentation in turn followed by efficient filtration, will efficiently and reliably reduce the initial hardness of water to practically any desired point, and a clear, innocuous effluent be delivered into the mains. Nevertheless, it must be pointed out that chemical accumulations rapidly form about the individual sand grains in filters treating such waters, and unless the sand is relieved of these coatings at suitably frequent intervals the filter becomes a mere strainer, and a poor one at that. Then, if chemical

precipitations pass over from the sedimentation basins, as they frequently will, the filters will arrest but a part of them and the rest go forward into the pipe distribution systems of the city. It is furthermore to be admitted that some of the precipitated or precipitating salts will enter the mains in any event, which of course is an undesirable feature of this process .

In some places troubles of this kind are more prevalent than in others, but they usually arise from softening plants of inadequate size, improper design or faulty operation. With proper attention paid to these features such troubles can be reduced to a practical minimum. In this event the benefits of the soft water far outweigh any difficulties experienced from deposits in the mains, service pipes, etc., including the cost of their periodic correction. The necessity of fresh (rain) water cisterns with their accompanying pumps, screens to prevent mosquito breeding, etc., are eliminated; there is an enormous soap saving in the laundry and kitchen; the life of delicate fabrics washed in the softer water is materially lengthened; the cost for boiler compounds is cut to a minimum and abnormal drain on the coal pile ceases; and generally the water supply is made more attractive and satisfactory both to the domestic and the industrial user.

The other form of water softening not yet referred to is that whereby through the passage of a hard water through a bed of insoluble sodium—aluminate—silicate the calcium and magnesium salts naturally dissolved in the water under treatment, and which make it hard, are extracted from the water by the exchange for them of the sodium base of the filtering medium. (Permutation.) The exchange silicate takes up the calcium and magnesium and gives a corresponding amount of sodium to the water. Water with a practically zero hardness results. To rejuvenate the filter it is periodically flushed with common salt solution after which it is ready for use again, having been thus restored to its original condition.

The advantage of this process over the lime-soda method of water softening lies particularly in the fact that its operation to give satisfactory results is mostly a matter of manipulation of mechanical parts. There is no necessity of carefully gauging the dose of the chemical, for no chemicals are used, the filtering medium (exchange silicates) doing the same work and actually accomplishing a better and more complete and reliable result in its own peculiar way. Furthermore, there can be no residual causticity, as is always the case with plants employing the lime-soda process, nor after-precoipitation in mains, service pipes, etc. If the raw water contains mud or other impurities, such matters are removed by suitable pretreatment and filtration before softening is undertaken.

In conclusion, I can answer your three questions, as set forth at the beginning of this communication, in the affirmative. Why municipalities will continue to force their citizens to waste soap to soften hard water; money to support the troublesome rain water cistern supply; abnormal amounts of coal to raise steam in badly incrusted boilers; coal waste again, to provide the increased pressures required to force the municipal supply through hardness-incrusted mains, etc., etc., is hard to explain. The average city of this country provides a satisfactory water supply as regards hygienic purity, but the same city has failed to date to take proper account of the hardness of the water. It is no extravagance of statement to say that unquestionably scores of cities in America would profit in a really big way by adopting water softening for their municipal supplies. It is certain that in numerous places the collective citizenry and industries are spending each year many times the cost of centralized water softening; and not only that, they are doing an imperfect job of it in most instances, and all around a far less satisfactory job than could be effected in centralized municipal water softening plants.

Very truly yours,

George A. Johnson,
Consulting Engineer.

150 Nassau St., New York, N. Y.
March 30, 1922.

EXPERIENCE IN CENTRALIZED WATER SOFTENING IN McKEESPORT, PA., MUSKOGEE, OKLA., AND GEORGETOWN, KY.

(Editor's Note: Mr. Alexander Potter, whose experience with and observation of centralized water softening has extended over a considerable period of years, has written us the following letter, discussing the subject.)

To the Editor:

The writer bases his answers to the questions put to him largely on his per-

sonal experiences with the plants designed and constructed by him for the cities of McKeesport, Pa., Muskogee, Okla., and Georgetown, Ky. All of these plants have been in operation for periods ranging from 10 to 15 years and so far as he knows are giving satisfactory results.

When the plant was put in service at McKeesport in 1908, local conditions compelled the use of the Youghlegany River, a stream highly polluted with mine drainage from the soft coal regions above and also from the pickling waters of galvanizing works.

It is not only economically feasible to soften an entire supply from a central station, but there are distinct savings in the light of results actually obtained. Perhaps an individual might consider that he is running his private softener at a cheaper cost to himself, but this is a rare condition. An examination and a close comparison will almost invariably show that he is not getting the uniformity of results which are possible at a central plant where the attendant is keeping constant watch of the condition of his raw water and varying his chemicals accordingly.

Such close control is certainly not practicable in a private plant although in large industrial plants it certainly pays to watch the variations in the raw water equally as well as it does in the average municipal plant.

What hope for success is possible in a small private plant where, for instance, at McKeesport, the writer has known the hardness to jump from 110 to 510 parts per million in a single day? Regulation is practically impossible in a private plant under such conditions.

During the war the price of soda ash jumped to such figures and the material was so hard to procure that the City of McKeesport changed over its source of supply to the very much less acid polluted water of the Monongahela.

The softening process used will depend largely on the composition of the raw water. For a highly acidulated water like the Youghlegany at McKeesport, the acids must first be neutralized by soda ash, and lime afterward applied. For waters hardened by contact with limestone, lime alone will suffice. Excellent results are obtained by the use of permutit.

The writer has had very little trouble with the clogging of service mains or fixtures, where the $CaCO_3$ is fully dissolved. The application of the lime in the form of lime water is the true solution for softening. The writer has recently inquired into the conditions at McKeesport, and finds that there has been a remarkable freedom from clogging of the services and none whatever of the mains. In fact, just before the softening plant was constructed, the city was negotiating a contract for the cleaning of the mains through the city, but the softened water was admitted to the mains but a very short time before the mains were entirely free from deposit.

At McKeesport the softening is followed by mechanical filtration and it has become necessary to remove the sand once in eight years, the experience with the accretion of sand grains following along the lines indicated at other places. The loss of sand in washing, due to the accretions, has been found to be more than compensated for by the fact that the lime retained in the sand beds did not pass on through the piping system and into the plumbing and fixtures.

As the writer views it, the essentials to a successful softening of the water are:

(1) Complete solution of the chemicals.
(2) A thoroughly baffled mixing chamber or equivalent mechanical agitation.
(3) An adequate period of sedimentation in a basin with a perforated bottom to insure at all times the full settling capacity of the tanks by blowing off the sludge daily or at less intervals without emptying the tanks.

Very truly yours,

ALEXANDER POTTER,
Consulting Engineer,
Plaza Hotel, Havana, Cuba.

Mar. 28, 1922.

FIRE SERVICE AS IT RELATES TO WATER SUPPLY

By Dow R. Gwinn, President and Manager, The Terre Haute Water Works Co., Terre Haute, Ind.

It goes without the saying that there must first of all be an ample water supply with reserve pumps, boilers, etc., and if the water must be purified, reserve filter capacity over and above the ordinary domestic demand.

Next, the distribution system must be large enough in diameter and sufficient in length to reach the built-up portions of the territory to be protected. The man who builds at a considerable distance from water mains is taking a risk and until the section is reasonably well built-

What One Town Did Another Can Do

Main Street, Arcade, N. Y., showing some of the buildings heated by steam from the Electric Light Plant.

Interior and Exterior of Municipal Light and Heat Plant, Arcade, N. Y.

Circular insert shows main leaving Light and Heat Plant for School Buildings across the street.

"COMMUNITY Water Supply," Commnuity Electricity," Community Gas," are so commonplace you give them no more than a passing thought. Are you equally familiar with "Community Heating"?

Arcade, N. Y., heats the business buildings and the school-house, using exhaust steam from the municipal electric light plant. The system will fully pay for itself in a very few years, and then will return about $5,000 net profit per year from a product formerly wasted.

But the profit is *greater* than this! There are reduced insurance rates, lessened fire risk, freedom from furnace-tending, no coal deliveries or ash collections.

For 40 years we have been installing "Community Heating" Systems for Industrial Plants, Institutions, groups of residences, etc., distributing steam through mains like water, gas, electricity; paid for similarly by meter.

Write for complete data regarding cost, operation and profits. Is there exhaust steam being wasted by any plant in your neighborhood?

Ask for Bulletin No. 20-M E on "Adsco Community Heating." Bulletin No. 158-M E describes "Adsco Heating" for individual buildings. Name of your architect appreciated.

AMERICAN DISTRICT STEAM COMPANY

GENERAL OFFICES AND WORKS
NORTH TONAWANDA, N.Y.

Offices:

30 Church Street, New York — First National Bank Bldg., Chicago — Hoge Building, Seattle

ADSCO HEATING

up, he will have only such fire protection as long lines of hose to the nearest hydrants will furnish. When there are still thousands of vacant lots with water and other utility service in a community, the man who builds out where houses are few and far between cannot expect water, gas, sewer and electric service.

Quantity of Water Required

As to the quantity of water necessary for fire purposes, I will quote from a report on Terre Haute by the committee on fire prevention of the National Board of Fire Underwriters:

"Protection.—Reasonable protection for the principal mercantile district requires a fire flow in excess of maximum domestic consumption of 6,500 gals. per minute, with a system of mains capable of delivering this amount about any block and hydrants so located as to deliver two-thirds of the quantity upon any large fire through hose lines, none exceeding 500 ft. in length; the total quantity includes an allowance for losses from broken services, elevator and sprinkler connections incidental to a large fire and should be available at pressures sufficient to give direct hydrant streams. In warehouses, manufacturing and minor mercantile districts, 3,000 to 4,000 gals. per minute are necessary, and in residential districts from 1,500 to 3,000 gals."

Care of Fire Hydrants

In the care of fire hydrants, it may be best to state the methods used at Terre Haute:

1. For a number of years it has been our policy to use 6-in. branch connections to hydrants with a 6-in. Gate Valve on the same, so that repairs may be made without shutting off the main line and possibly other hydrants.

2. All fire hydrants have brick drain pits at the base, opposite the drain openings. These pits are open at the bottom and are about 1 cu. ft. capacity. They facilitate the quick draining of the hydrants.

3. Hydrants are flushed in the Spring and Autumn—usually in April and September. This is for the double purpose of cleaning the distribution system and for examination of hydrants—to determine if they are in good working order. On the occasion of a recent flushing, two hydrants were found to be broken below the surface of the ground; there was nothing in their appearance that would indicate that they were broken. In the past two years, we have had about 20 fire hydrants broken by automobiles. In a number of cases the broken hydrant stocks were welded at a cost of about $8 each. A record is made of hydrants that are hard to open, those that do not drain, that leak through the waste when open fully, and any that require attention. These are attended to promptly. All our fire hydrants open by turning to the left. We have a hydrant with a portion of the stock and front case cut away; this is used to show the firemen how a hydrant is operated.

4. Inspections are made just before Winter begins and the most important hydrants are inspected from time to time during very cold weather. This is done by removing the nozzle cap and dropping into the hydrant a weight attached to a cord. Notwithstanding our repeated inspections, we occasionally find a hydrant with water in it, due to ground water getting in through the drain opening or through a small leak in the main valve.

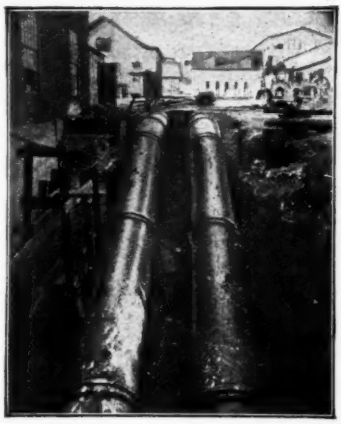
5. We carry in stock hydrants of different sizes and makes and these are substituted for those that are out of order. By this plan, the hydrants are available promptly for the Fire Department and we repair the removed hydrants when convenient.

6. If a hydrant should be found with ice in it, salt and hot water are used for thawing.

7. The Fire Chief is notified immediately when a hydrant is found out of order, due to being broken by automobiles or to freezing; also whenever it is necessary to shut off a main line. This information is sent by the Chief to the different fire houses. When a hydrant is restored to service, the Chief is notified.

8. Fire hydrants are for extinguishing fires and as far as possible should be kept sacred for that purpose. When water is needed by the city for flushing a sewer, we are notified and our man goes out, attaches an auxiliary valve on one of the nozzles and then opens the hydrant full. The City men use the auxiliary valve and when through with the water, they telephone our office and our man closes the hydrant and removes the auxiliary valve. No charge is made for the water or for the time. When water is furnished for a circus or to a contractor from a fire hydrant, we use auxiliary valves, but our man remains on the ground and we are paid for his time as well as the water.

9. When a fire alarm is received, a record is made of it and one of our inspectors is given an order to examine the hydrants that are used and report on their condition.



Conveying Abrasive Material

Cast Iron Pipe

The greatest copper reclaiming plant in the world is that of the Calumet & Hecla Mining Co., on the shores of Torch Lake, an arm of Lake Superior. Fifty million tons of mill tailings, which have accumulated here during the past 50 years, are now being dredged and pumped out through two lines of cast iron pipe shown here, at the rate of thousands of tons, daily, to tanks in their ammonia leaching plant. No other pipe has been found to withstand this severe service so well.

Write for Booklet.

United States Cast Iron Pipe & Foundry Co.

General Office, Burlington, New Jersey

SALES OFFICES:

Philadelphia: 1421 Chestnut St.
Pittsburgh: Henry W. Oliver Bldg.
New York: 71 Broadway
San Francisco: Monadnock Bldg.
Chicago: 122 S. Michigan Blvd.
St. Louis: Security Bldg.
Birmingham: 1002 American Trust Bldg.
Dallas: Scollard Bldg.
Kansas City: Interstate Bldg.
Minneapolis: Plymouth Bldg.
Cleveland: 1150 E. 26th St.
Buffalo: 957 E. Ferry St.
Cincinnati: Dixie Terminal Bldg.

STEWART SEWER CLEANING MACHINE

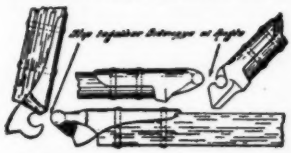
Water Cleaning System, if you wish it, or Drag Bucket type.

Also have TURBINE SEWER CLEANING MACHINE at Low Price.

WE WILL PAY FREIGHT AND CHARGE TO BILL.

We Ship Rods for Trial—who else will do this?

We also make a Rod that will float. Also Rods with wheels for conduit work.



SEWER AND CONDUIT RODS

No Deep Shoulder Cut for Couplings. Rods retain full size and strength.

Investigate our JUMBO ROD

W. H. STEWART

1614 Locust Street . . ST. LOUIS, MO.
129 George Street . . BOSTON, MASS.

CANADA FACTORY, WALKERVILLE, ONT.
Therefore No Duty for Purchaser to Pay.

PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO.

CUT that NEXT JOB with a

STRICKLER

Ratchet Pipe Cutter

Cuts either Cast or Steel pipe. Cuts a channel in the pipe same as a lathe cut.

Each size cuts a range of sizes. Catalog on request.

W. W. STRICKLER & BROS.

COLUMBUS, OHIO.

ACME

Manholes, Catch Basins, Inlet Basins, Park Basins (All Styles)

Regular and Special Grates or Strainers for Sewer Pipe

Building Columns of All Descriptions

Send Us Your Specifications

MADISON FOUNDRY CO.

927 Addison Road, CLEVELAND, OHIO.

10. A copy of the Fire Alarm Record, which is the order for inspecting hydrants after they have been used by the Fire Department, is shown herewith:

Fire Alarm Record

Date.....191....:
Location of fire.....
Alarm received (time).....
Alarm received by .....
Box No.....By A. D. T. No.....
Average fire pressure, outlet of filters.....
.....Pounds
From.....M. to.....M.
Time of receiving second alarm.....M.
Notified Mr. .....at.....M.
Notified Mr. .....at.....M.
Notified Mr. .....at.....M.
Notified Office, Mr.....at.....M.
Strike out signal received.....M.
Strike out signal received by.....
Pumpage rate, No. 7.....No. 5.....
No. 4.....Total Rate.....
Remarks .....
.....
.....
.....

OVER

RECORD OF FIRE HYDRANTS USED.
Character of Fire, Etc., Etc.
Hydrants used and condition after fire.
Location Condition
.....
.....
.....
.....
.....
.....
.....
Remarks .....
.....
.....
.....
Inspection made this.....day of .....19.....
.....
Inspector.
Fire Loss $.....

Gate Valves

Our policy is to reduce the size of the districts and as we have an opportunity, we set additional valves. In the outskirts we endeavor to make districts 750 to 1,250 ft. in length. With valves on fire hydrant branches, it is seldom necessary to shut off a district. Valves are located on the property line, or within 1 ft. of the line. This is a help in finding them. On paved streets, we build a brick well or pit around the valve.

About two years ago we abandoned the plan of using gray iron covers and are now using malleable iron covers. This change was made on account of the breaking of gray iron covers by heavily loaded trucks. Municipal and County Engineering published a paper on this subject in the February, 1922, issue.

We try to examine all valves in the distribution system (except those on hydrant branches) annually. The valves are closed and opened to determine if they work freely. In most cases, we find that the cause of a valve operating hard is in the gland on the stuffing box, due to corrosion. This can be remedied by scraping with the blade of a pocket knife.

We have a skeleton map of our pipe system with tracing from which blue prints are made, drawn to approximate scale of 1,000 ft. to the inch. The skeleton map for our 104 miles of mains is 30x21 ins. and folds up in a loose leaf binder 4½x7 ins. outside measurement. Each valve on the main lines is shown by a short right angle dash and bears a number at the side. Locations of the valves are shown opposite a corresponding number on sheets 4x6⅞ ins., which are placed in the loose leaf binder along with the blue print map. The headings are, Valve No.—Size—Looks—Turns—Box Well—Make—Ft.—In.—of—Prop. Line—Ft.—In.—of Prop. line. As only one line is used for each valve, 15 locations are provided on each sheet. By reference to the map, it is readily seen what valves are necessary to shut off a district and the exast locations are found on the sheets by looking up the corresponding numbers. One heading is sufficient if pasted on the inside of the left hand cover. The locations may be made on a typewriter, making manifold copies for extra books, or they may be printed on tracing cloth for blue printing. We have also photographed the tracing cloth drawings and thus were able to make smaller books. Every man who has occasion to shut off main valves carries one of these books with him.

Our men are instructed to report on their work order just what valves they have closed, giving the date and hour when closed and when opened.

We carry in stock for making repairs, complete valves except the body or lower casting, of the different makes of valves, so that when a valve is out of order, it can be repaired quickly. All valves in the distribution system close by turning to the left.

Effect of Raising Fire Pressure

This subject is receiving a good deal of attention just now, owing perhaps to the splendid development of motor pumpers and also to the realization of the danger of broken mains when high pressure is applied. It may be of interest to give a copy of the resolution which was adopted unanimously in November, 1921, at the Convention of the Iowa Section of the American Water Works Association. It was as follows:

"Whereas, There are serious objections to the practice of raising water pressure on systems of water mains at time of fire, and

"Whereas, The increase of pressure in

itself results in more water being discharged through the numerous leaks, which always exist, and more water being used through fixtures, damage to plumbing, in the breaking of service pipes, and, at times, the breaking of large mains; all at a time when the whole water supply should be strictly conserved, and

"Whereas, accidents to pumping machinery and valves are more apt to occur, and do occur, under the additional strain and during the excitement of raising fire pressure: also increased pressure ordinarily requires that water stored in elevated reservoirs is not available because of being shut off to permit direct pumping into the mains, so that at such times an extra strain is placed upon filter plants and there is consequent danger of epidemic following a conflagration, and

"Whereas, in handling fires in high buildings, and in the case of other serious hazards, fire departments now require large and powerful streams far beyond the capacity of domestic water works systems to supply, and

"Whereas, such streams can be furnished by motor pumpers which are well adapted to this requirement and make shorter and more lines of hose available without the heavy expense for equipment and operation which was formerly required in the case of steam fire engines,

"Therefore, Be It Resolved, by the Iowa Section of the American Water Works Association in convention at Omaha, that we recognize the hazard and expense incurred in raising fire pressure in domestic water mains and we declare it is our opinion that this is undesirable practice and that such method of producing fire pressure should be supplanted as rapidly as may be by motor pumpers or other auxiliary apparatus as being more suitable, more economical and in the best interest of the whole people."

The resolution was prepared by Mr. Ch rles R. Henderson, Manager of the Davenport (Iowa) Water Co., and a Past President of the American Water Works Association. Mr. Henderson is one of the best posted, most wide-awake and most efficient water works managers in the country. His views are valuable because he is so thorough. Therefore, when Mr. Henderson advocates a method of doing things, I believe there must be merit in it.

In a recent number of Fire & Water Engineering there appeared an interesting article from one who has served as a fireman. The author was Sherwood B. Brockwell, ex-chief of the Raleigh, N. C., fire department, now Safety Engineer, North Carolina Insurance Department. Mr. Brockwell is a graduate engineer and presented his views before the North Carolina Section of the American Water Works Association. The headlines were as follows:

"FIRE ENGINES BETTER THAN DIRECT PRESSURE."

"They and larger mains, according to this well-informed author, are the necessities for proper fire protection."

Extracts from Mr. Brockwell's paper:

"The time has now come when it is no longer necessary for water works engineers to try to combine the functions of a water works system and fire apparatus. * * * The fire chief is, during the time of a fire of any consequence, up against two propositions neither of which will help him any—low pressure fire streams or the entire system under an undue strain and even with the direct pressure, subjecting, as it does, all mains, pipes, appliances and machinery to rupture, the chief could not get a standard fire stream from a third line of hose in the uptown or congested district. * * *

"Very few people not trained in fire fighting know the value of this third stream. * * * The first company arriving attaches to the nearest hydrant and the men at the nozzle attempt to reach the heart of the fire. The second company to arrive attaches to the next nearest hydrant and attacks the fire at a point where it seems most likely to spread. The chief, as a rule, arrives while these two lines are being stretched and the third line is invariably his engineering line. The two nearest hydrants are being used so this third line is stretched from the hydrant on the next corner. Now what does that mean? * * *

"Say he gets away with 600 ft. or 12 sections of hose and a 20 ft. elevation —starting with the maximum pressure of 125 lbs., two streams already flowing, this third stream reaching him through 600 ft. of hose and elevated to 20 ft.—Messrs. Freeman and Ellis will tell you what kind of a stream he gets—it would not be apropos to use the fire chief's language in a meeting of this kind. Suffice to say with 125 lbs. pressure he cannot get a fire stream and over 125 lbs. on the mains would be the height of indiscretion.

"As a fireman talking to engineers whose opinions are taken above the fire

chief's in matters of this kind and far too often above that of the superintendent of water works, by the average city council, I urge you gentlemen seriously to consider confining your efforts in fire protection to supplying the volume of good water in sufficient sized mains and then impressing upon the city councils the necessity of providing the necessary fire apparatus with which to convert this volume into effective fire stream."

The danger of having broken mains due to high pressure and jeopardizing the fire service is real. Some years ago, during a factory fire in Terre Haute, a 6 in. main was broken at a point near the fire. The result was a serious drop in the pressure, as the line was supplied from both ends, one being a 16 in. line about 70 ft. distant. It took probably an hour to shut off the district. The ground was frozen and some of the boxes were covered with ice.

If there had been another fire in the high hazard district when the broken main was discharging large quantities of water, it would have been impossible to furnish proper fire pressure and the results might have been a serious conflagration.

Another point should be considered in connection with raising fire pressure—that is the breaking of service pipes and leaks through water closets. In Terre Haute, at fires where the pressure is raised, but where no water is used, not a single hydrant being opened, the pumpage is increased at the rate of two million gallons per day. Many water closets are adjusted to the normal domestic pressure and when the pressure is increased, the closets start to run and probably continue to run for some time. Every small leak discharges more water when the pressure is increased.

This means that there is two million gallons capacity that is not available for fire purposes. It also means where the service is on the meter basis, increased consumption recorded by the meters with consequent increase in payments by private consumers. If only the normal domestic pressure was maintained, the leaks in water closets and service pipes would be materially reduced and the danger of broken mains when water was needed for fire service would be reduced to the minimum.

The foregoing paper by Mr. Gwinn was presented at the recent annual meeting of the Indiana Sanitary and Water Supply Association.

THE ABUSE OF SANITARY SEWER SYSTEMS

By J. A. Stewart, Civil Engineer, 1309 Traction Bldg., Cincinnati, Ohio.

Unjust criticisms of sanitary sewerage systems by the public (especially residents of the smaller incorporated villages and towns) has caused many smaller communities to delay the installing of proper facilities for the disposal of sewage for many years until their financial condition would permit them to construct a combined system. The result being that the small streams, dry ravines and even street gutters and roadway ditches are polluted with sewage, the overflow from cess-pools not properly constructed or cared for, which oftimes causes epidemics. This could have been avoided by the construction of a strictly sanitary system, the cost of which would not have exceeded their assessment and taxing limitations.

The complaints of the inadequacy of the sanitary system can only be attributed to the misunderstanding of the fundamental principles of sanitary engineering.

It is not the system but the inexcusable abuse of it by property owners, municipal employees and plumbers that cause this unjust criticism by the general public.

The prime object of the system is to provide for the sanitary flow with a reasonable allowance for ground-water. The size of the conduits can be calculated to within an error of approximately 10%.

In my investigations of many sanitary systems I have not discovered one that was taxed to one-half of its capacity in dry weather, but they were all overloaded during heavy rainfalls, proving conclusively, that the supervising officials had permitted the connection of roof water leaders with the sanitary sewers, although there was an ordinance in force at the time in the city or village strictly forbidding such connections.

I have found many instances where the employees have actually connected inlets and catch basins with the sanitary sewer, expecting the small pipe to carry off the storm water flow. This of course resulted in flooded cellars at various points in the system and furnished plausible arguments against the system for property owners who did not realize that the trouble had been calsed by the abuse of the system by employees and officials of the municipality.

The attention of municipal officials, plumbers and the general public should be called to the abuses, and their co-operation in the proper use, care and maintenance of the system secured.

EXPERIENCE WITH THE CITY MANAGER PLAN

By Robert E. McDonnell, Consulting Engineer, Interstate Bldg., Kansas City, Mo.

How is the City Manager form of government working out in actual practice? The inquiries sent out to cities by the Chamber of Commerce of Sacramento, Cal., brought the following replies from prominent authorities outside the City Government.

Akron, Ohio—"Since the establishment of the City Manager form of government definite results showing the value of centralized administrative power in the hands of an expert, have been achieved."

Grand Rapids, Mich.—"It has resulted in economy in City Affairs with increased efficiency, and the people appear to feel satisfied that it is a great improvement."

Norfolk, Va.—"Its superior efficiency is so generally recognized that under no circumstances would we return to the former system. Wonders have been worked in Norfolk since the City Manager form of government was inaugurated. It has the enthusiastic support of the people of this city. Norfolk saved $100,000 of its annual budget the first half of its present fiscal year."

Wichita, Kas.—"It is an ideal business form of government as it carries out all the sound, well-established principles that govern private business."

Phoenix, Ariz.—"I am sure that you could not get a business man in Phoenix to go back to the old style of government."

Springfield, Ohio—"The City Manager plan has given Springfield more for the taxes paid than ever before.

Wheeling, W. Va.—"The City Manager plan has been successful in every way in Wheeling. It has met expectations and is giving efficient government."

There are now 5 cities of more than 100,000 population successfully using the City Manager plan: Akron, 208,000; Dayton, 154,000; Grand Rapids, 138,000; Nashville, 118,000; Norfolk, 116,000, and Cleveland with 800,000 or more than twice the size of Kansas City, adopted it recently with 17,000 majority.

Will it work in the larger cities? We do not wish to admit that because of our size we should be content or satisfied with a less efficient plan of government than exists in smaller cities.

The principles involved in the government of large cities are identical with those of smaller municipalities. The manager plan has worked best in the larger cities. The administration becomes more impersonal. The funds available in larger cities make it possible to secure better experts as heads of departments. Specialists can be secured for investigating water supply, sewerage and garbage problems. Experience of City Managers proves that success is easier in the larger cities.

From the standpoint of an engineer, having for 25 years served as expert in municipal problems, to over 400 cities, 27 of the 400 being city managed, I can unhesitatingly state that it is by far the best plan of City Government yet devised and its growth by leaps and bounds is fully justified.

In conclusion, the 12 years' working of City Manager cities shows it is a plan far superior to anything heretofore tried. Perfection is not claimed for it, but its weak features are rapidly being eliminated and much of the success accomplished is due to the greater human interest taken by the citizens in a form of government in which the people have a voice and can see the good results.

The foregoing is from an address by Mr. McDonnell before the Kansas City Council of Clubs, an organization representing 63 civic clubs in Kansas City.

New Automatic Cement Tester

Grand Prize Panama-Pacific International Exposition, 1915.

Manufacturers of Cement, Concrete, Brick and Road Material Testing Machines and All Auxiliary Laboratory Apparatus

TINIUS OLSEN TESTING MACHINE CO. 500 North Twelfth St. PHILADELPHIA, PA.

SEWER PIPE — FIRE BRICK

Flue Linings — Wall Coping — Steam Line Conduit — Sewage Disposal Tanks — Fire Clay Meter Boxes

IN STRAIGHT OR MIXED CARS. Manufactured of OHIO RIVER FIRE CLAY.

CANNELTON SEWER PIPE CO., Cannelton, Ind.

Water Works Equipment Service

If in the market for any of the following water works equipment, so indicate by check marks, mail this page to *Municipal and County Engineering,* 702 Wulsin Building, Indianapolis, and price quotations and descriptive literature will be forwarded to you.

—Air Compressors
—Air Lift Pumps
—Ash Handling Mach'y
—Backfillers
—Brass Goods
—Chimneys
—Chloride of Lime
—Chlorinators
—Coal Handling Machinery
—Concrete Hoisting Equipment
—Concrete Tanks
—Condensers
—Conduit Rods
—Cranes, Locomotive
—Cranes, Traveling
—Curb Boxes
—Curb Cocks
—Derricks, Pipe Laying
—Derricks, Steel Portable
—Drinking Fountains
—Dry Feed Chemical Apparatus
—Engines, High Duty
—Engines, Gas
—Engines, Oil
—Engines, Pumping
—Explosives
—Fence, Iron
—Fittings, Wrought
—Filter Equipment
—Gates, Sluice
—Gauges, Recording
—Gauges, Steam
—Gauges, Water
—Goose Necks
—Hydrants, Fire
—Indicator Posts
—Lead
—Leadite
—Lead Furnaces
—Lead Wool
—Leak Indicators
—Liquid Chlorine
—Lime
—Meter Boxes
—Meter Couplings
—Meter Testers
—Motor Trucks
—Motors, Electric
—Oil, Lubricating
—Pipe, Cast Iron
—Pipe Cutters
—Pipe, Lead-Lined
—Pipe, Steel
—Pipe, Wrought Iron
—Pipe, Wooden
—Pitometers
—Pumps, Air Lift
—Pumps, Boiler Feed
—Pumps, Centrifugal
—Pumps, Deep Well
—Pumps, Steam
—Pumps, Trench
—Pumps, Turbine
—Pumping Engines
—Service Boxes
—Soda Ash
—Specials, Cast Iron
—Standpipes
—Steam Boilers
—Steel, Reinforcing
—Sulphate of Alumina
—Tamping Machines
—Tanks, Elevated
—Tapping Machines
—Trench Braces
—Trenching Machines
—Valve Boxes
—Valve Inserters
—Valves, Gates
—Valves, Pressure Regulating
—Water Main Cleaners
—Water Meters
—Water Softening Plants
—Welding Apparatus
—Well Drills
—Well Screens
—Well Strainers

Engineers' and Contractors' Directory

ALVORD, BURDICK & HOWSON
John W. Alvord Charles B. Burdick Louis R. Howson
ENGINEERS FOR
Water Works Water Purification Flood Relief
Sewerage Sewage Disposal Drainage
Appraisals Power Generation
Hartford Bldg. CHICAGO

THE AMERICAN APPRAISAL COMPANY
A QUARTER CENTURY OF SERVICE
MILWAUKEE — CHICAGO — NEW YORK
APPRAISALS RATE INVESTIGATIONS
FINANCIAL REPORTS

Wm. Artingstall
Civil Engineer
WATER SUPPLY SEWERS SEWAGE DISPOSAL
Old Colony Building Chicago

CHAS. BROSSMAN
CONSULTING ENGINEER
Water Supply. Sewerage and Disposal. Lighting Plants—Supervision of Construction and Reduction in Operating Cost. Appraisals—Expert Testimony.
Merchants Bank Bldg. INDIANAPOLIS, IND.

BURD & GIFFELS
CIVIL ENGINEERS
POWER DEVELOPMENTS WATER SUPPLY
SEWERAGE
KELSEY BUILDING GRAND RAPIDS, MICH.

CHICAGO PAVING LABORATORY
L. Kirschbraun H. W. Skidmore
CONSULTING and INSPECTING ENGINEERS
PAVEMENTS and PAVING MATERIALS
Consultation, Design, Specifications, Reports, Testing, Inspection and Research.
160 North Wells Street CHICAGO

CITY-WASTES DISPOSAL CO.
(Organized from Staff of Col. Geo. E. Waring, Jr.)
Consulting Engineers. Specialists in Drainage, Sewerage and Sewage Disposal. Preliminary Investigations and Estimates, Surveys, Plans and Supervision. Sanitary Examinations and Reports.
45 Seventh Ave. NEW YORK.

DOW & SMITH
CHEMICAL ENGINEERS
Consulting Paving Engineers
A. W. DOW, Ph. B., - Mem. Amer. Inst. Ch. Engrs.
F. P. SMITH, Ph. B., - Mem. Amer. Soc. Civil Engrs.
Asphalt, Bitumens, Paving, Hydraulic Cement, Engineering Materials
131-3 E. 23rd Street NEW YORK CITY

FARGO ENGINEERING CO.
ENGINEERS
Water Supply. Steam and Hydraulic Power Plants. Advice as to Reduction in Operating Costs. Reports and Estimates for Bond Issues.
230 W. Cortland St. Jackson, Mich.

WALTER H. FLOOD & CO.
PAVING LABORATORIES
Plant and Street Inspection. Testing and Inspection of Materials.
Offices: 22 Quincy St. Laboratories: 742 E. 39th St.
CHICAGO, ILL.

Nicholas S Hill Jr S. F. Ferguson
HILL & FERGUSON
CONSULTING ENGINEERS
WATER SUPPLY—SEWAGE DISPOSAL—
HYDRAULIC DEVELOPMENTS
Reports Investigations Valuations Rates. Design Construction Operation Management.
Chemical and Biological Laboratories.
112 E. 19th Street New York City

J. W. HOWARD
CONSULTING ENGINEER
ROADS AND PAVEMENTS
Laboratory Analyses and Tests. Specifications improved.
Expert in Valuation and Litigation. 32 years' experience.
1 Broadway NEW YORK CITY

ROBERT W. HUNT & CO., Engineers
Inspection — Tests — Consultation
PAVING MATERIALS, CAST IRON PIPE, STEEL AND CEMENT
Chemical Cement and Physical Laboratories
2200 Insurance Exchange CHICAGO, ILL.

CONSULTING ENGINEERS
—reach city officials by inserting professional cards in this Department.
A Daily Bulletin, covering prospective work in all parts of the country, goes free to each advertiser. Write for rates and full information to
Municipal and County Engineering

SAM L. JONES, Consulting Engineer
PAVEMENTS and ROADS
Specifications, Estimates and Cost Systems
807 Second Nat'l Bank Bldg. CINCINNATI, OHIO

W. G. KIRCHOFFER
Sanitary and Hydraulic Engineer
Water Supplies Water Purification Sewerage
Sewage Disposal Land Drainage
22 N. Carroll St. MADISON, WIS.

WILLIAM F. MORSE
CONSULTING SANITARY ENGINEER
The Design and Construction of Installations for the Disposal of Municipal, Institutional and Industrial Refuse. Investigations and Reports on any Question of Treatment and Final Disposal of Waste Material.
10074 Kee Mar Park CLEVELAND, OHIO

H. C. NUTTING COMPANY
Inspection Engineers and Chemists
Hunt and Broadway CINCINNATI, O.
Analyses of all Road Building Materials—
Tar Cement Bitumens Structural Steel
Lime Brick Road Oils Reinforcing Steel
Specifications of any kind submitted upon request

ALEXANDER POTTER, C. E.
HYDRAULIC ENGINEER AND SANITARY EXPERT
50 Church St., New York City
Sewerage and Sewage Disposal, Water Supply and Purification, Water and Electric Power.
Valuations of Existing Plants where MUNICIPAL OWNERSHIP is Contemplated—Expert Testimony—Plans and Estimates.

ASTRID S. ROSING, Inc.
Sewer Pipe—Drain Tile—Steam and Electric Conduits—Building Tile—Fire Brick
Harris Trust Building, CHICAGO, ILL.

SULLIVAN, LONG & HAGERTY
GENERAL CONTRACTORS
Builders of Sewer Systems and Water Works Plants
Home Office, BESSEMER, ALA.

Testing, Consultation, Bitumens, Paving, Inspection, Specifications, Asphalts, Road Oils.
ISAAC VAN TRUMP
ENGINEERING CHEMIST
2337 South Paulina Street. CHICAGO, ILL.

JAMES P. WELLS, HYDRAULIC ENGINEER
Surveys, Estimates of Cost of Proposed Work, Reports on New Improvements, Preparation of Plans, Supervision of Construction, Dams and Reservoirs, Pipe Lines, Filtration Plants, New Water Supply Systems, Hydro-Electric Power Plants.
Main Office, 249 Cutler Bldg., Rochester, N. Y.
Chicago, Ill. New York City. Knoxville, Tenn. Toronto, Ont.

CHLORIDE OF LIME
FOR PURIFYING WATER
PENNSYLVANIA SALT MANUFACTURING CO.
Widener Building PHILADELPHIA, PA.

SLUICE GATES
Sheer, Flap and Butterfly Valves
FLEXIBLE JOINTS
COLDWELL-WILCOX CO.
South Water St. NEWBURGH, N. Y.

WM. E. DEE COMPANY
30 North LaSalle St. CHICAGO, ILL.

Patent Numbers—965163-1177850
WE MANUFACTURE
D & D Safety Cover
Guaranteed not to Rattle or Dish.
Full Line of MANHOLE and CATCH BASIN COVERS of all kinds.
WRITE FOR OUR PRICES

VALVES & FITTINGS
FLOWER COMPANY
DETROIT, MICH.
DETROIT FILTRATION PLANT LARGEST IN THE WORLD
FLOWER HYDRAULIC AND HAND OPERATED VALVES, SLUICE GATES, SPECIALS, ETC.,
ASE USED THROUGHOUT THIS SIX MILLION DOLLAR PLANT.

STANDARD AND HIGH PRESSURE FIRE HYDRANTS	CAST IRON, STEEL AND BRASS VALVES
SLUICE GATES	FILTRATION SPECIALS
TAPPING VALVES AND SLEEVES FOR WATER AND GAS TAPPING MACHINES	CAST IRON AND STEEL FITTINGS
FABRICATED STEEL PIPE	GRAY IRON CASTINGS

Construction News and Equipment

FURTHER SIMPLIFICATION OF PAVING BRICK VARIETIES

Four months ago there were 66 types and sizes of vitrified paving brick being manufactured throughout the United States, specified by engineers and used in paving streets and highways. Today there are only seven recognized types and sizes.

This elimination comes about as the result of co-operative action on the part of engineers representing the principal national engineering organizations, the Bureau of Simplified Practice of the U. S. Department of Commerce, and representatives of the paving brick manufacturers of the United States. It comprises the first concrete results of Secretary Herbert Hoover's campaign to eliminate waste in industry by eliminating excess and needless varieties.

At the first meeting of representative producers and buyers, held Nov. 15, 1921 in Washington, only 11 of the 66 types and sizes were retained. At that time a permanent committee was appointed to consider further eliminations and to influence the general acceptance of the recognized types and sizes.

The permanent committee held its first meeting in Washington, March 27, 1922. The committee was informed that the following organizations already had formally approved the first eliminations: National Paving Brick Manufacturers Association; American Association of State Highway Officials; American Institute of Architects; American Ceramics Society, Engineers Club of Columbus; Indiana Engineering Society; Western Society of Engineers; American Society of Civil Engineers; the Departments of Agriculture, Commerce, Interior, Navy and War.

After considering new data as to total shipments of vitrified brick for 1921 the committee voted unanimously to eliminate the following sizes:

Vertical Fiber Lug..... 3x4x8½ in.
Vertical Fiber Lug.... 3½x4x8½ in.
Wire-Cut Lug Hillside.. 3½x4x8½ in.
Repressed Lug .....3½x3½x8½ in.

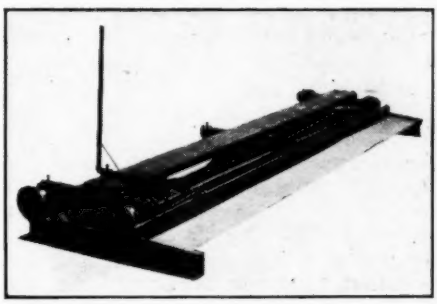
The following remain as the seven recognized types and sizes:

Plain Wire-Cut..... 3x4x8½ in.
Plain Wire-Cut..... 3½x4x8½ in.
Repressed Lug .....3½x4x8½ in.
Wire-Cut Lug..... 3½x4x8½ in.
Wire-Cut Lug..... 3½x3½x8½ in.
Wire-Cut Lug..... 3½x3x8½ in.
Repressed Hillside ....3½x4x8½ in.

The committee decided that with four eliminations it had proceeded as far as was desired until there were further reactions from producers and consumers. It was therefore concluded that no further eliminations would be considered until March-1923 at which time data on 1922 shipments would be available to serve as a guide.

THE LAKEWOOD FLOAT-BRIDGE

The Lakewood Engineering Company, of Cleveland, has brought out a new item of equipment for concrete road construction known as the Lakewood Float-Bridge. This was exhibited at the Chicago Road Show this year and met with approval of both Contractors and Engineers.



THE LAKEWOOD FLOAT-BRIDGE.

The Float-Bridge, as shown by the picture, is exactly what the name implies—a hand operated belt float and substantial bridge combined. One man operates the lever which moves the belt back and forth across the pavement, at the same time automatically advancing the machine a little with each stroke. The traction mechanism can be instantly thrown out of gear so that the Float-Bridge can be

pushed forward or backward. The belt can be raised off the pavement and is automatically held up until released.

On many concrete paving jobs it has been found that a final belting, some little time after the pavement has been struck off, tamped, and surfaced, does much to prevent hair cracks and also gives a better surface. Time does not allow the finishing machine to go back and do this final belting, and it was primarily for this work that the Float-Bridge was developed. It also gives the contractor doing hand finishing a one-man operated belting device.

Another big advantage of the Float-Bridge is that it provides a strong bridge across the road, carried on wheels traveling on the side forms, which is easily moved by one man.

DUMORITE REDUCES BLASTING COSTS

Reports from various parts of the country show that "Dumorite," the new explosive, recently put on the market, is effecting reductions in blasting costs amounting to one-third and more. Statements from users show this is especially true in quarry, farm blasting and other open work, because the new dynamite frequently shoots stick for stick with regular 40 per cent dynamite while at the same time each case contains at least one-third more cartridges.

A quarry company in the Middle West reports that in their operations, Dumorite is materially reducing blasting costs. In eastern quarries, equally good results have been obtained.

Experimental work in stump blasting had already shown that Dumorite was an important money-saver for the farmer. A blaster of Worsham, Virginia, is using it and reports: "I want to advise that I find it as good stick for stick as any 40 per cent dynamite I have ever used and as it has 33 per cent more sticks per case than any 40 per cent dynamite I have ever used, it cut the cost of blasting out stumps just 33 per cent. Besides there was no headache caused from using it and this feature alone appeals to the farmer."

In states where large stumping operations are under way, experience is also showing that the new explosive is a great boon to farmers, since it enables them to make an important slash in blasting costs.

These reports follow out the statements made concerning the explosive at the time it was perfected. The Du Pont Company then announced that "Dumorite" was manufactured on a double base of modified nitroglycerin and guncotton, that it could not freeze and would not produce headache. This last advantage, combined with the saving in blasting costs, is causing it to be regarded as the most advantageous explosive on the market at this time.

IOWA PROCEDURE IN GRAVEL ROAD CONSTRUCTION

By J. F. Reynolds, District Engineer, Iowa State Highway Commission, Storm Lake, Iowa.

One of the first questions that usually comes up in any discussion of gravel roads is the question: "Should we pave or should we gravel?" When we analyze the situation, there is no argument. It is entirely a question of traffic. It would be very poor engineering to pave a road that can be maintained as a gravel road. On the other hand when the traffic becomes so heavy on a road that a good riding surface cannot be maintained with gravel, there is only one thing left to do and that is pave. If this situation was clearly understood by the people of the State of Iowa, the way would then be clear to the harmonious solution of the road question, and we could go forward to better roads, by eliminating arguments and pulling together. Remarks of this kind may appear unnecessary to a gathering of professional engineers, but the fact remains that this question is continually agitated by newspapers, politicians and even by some persons claiming to be engineers, said Mr. Reynolds in addressing the Iowa Engineering Society recently.

A greater advance in the methods used in the construction of gravel roads has been made in the past two years in the State of Iowa than in all previous years put together.

The Gravel

The first thing we consider, of course, is the material available. In judging various gravel deposits, the important screen test is no longer the amount of material retained on a ¼-in. screen, but is more nearly the material retained on a ⅛-in. screen. Gravel passing a ¼-in. screen but retained on a ⅛-in. screen is excellent material. The very best material we could get for gravel road construction would be a material well graded and ranging in size from ⅛-in. to material that will pass a 1½-in. screen.

Clean Gravel

It has long been thought that a certain amount of clay binder was necessary in constructing a gravel road. After observation of roads constructed with both clean gravel and gravel carrying a percentage of clay, I have come to the conclusion that the cleaner the gravel is when it goes onto the road the better road we will have. It is true that clean gravel will not pack as quickly as gravel carrying a percentage of clay, but when it does pack it gives a much better wearing surface and the necessary clay for binding the material is worked up from the subgrade. Looking at it in another way, it is very foolish to pay for hauling clay from the source of supply to the road and to pay for the clay by the cubic yard when there is plenty of this binder material in the subgrade itself. There is only one place where I will consider adding binder to the gravel and that is where a gravel road is being constructed over a

The next thing we consider in a gravel road construction is the subgrade. Of course, it has been long conceded that it is necessary that the subgrade be well drained, but it was only a couple of years ago when practically all counties were depositing gravel on a crowned subgrade and attempting to place the gravel in a position in which they wanted it packed. At present we insist on a level subgrade. The right man can take a 12-ft. blade grader and so shape the road that good shoulder lines are left and the surface is level from shoulder to shoulder.

Placing the Gravel

After the adoption of the flat subgrade we still for some time attempted to place our gravel on this subgrade, just as it is shown on the plans. The result was that traffic would go to the shoulders of the road and would have exceedingly difficult going until the gravel packed. If this gravel was traveled on a sufficient length of time it would apparently pack on the subgrade. This would soon be broken up by heavy traffic and leave the road pitted and full of holes. It was almost impossible to maintain a smooth riding surface on the roads built in this way.

After attempting various methods of placing the gravel we finally came to the one that is now commonly in use. The gravel is deposited in the center of the road and spread out wide enough so that there remains only about an inch of material in the center. The balance of the material is on the shoulders. Under maintenance this material is brought towards the center of the road as fast as the gravel is packed. This leaves a road that at all times during construction is an easy riding road and traffic at no time encounters deep, loose gravel. If the material is brought in from the sides, we have a gravel road that is compacted from the bottom up.

A very common method of determining whether or not the gravel is properly spread is to observe the lines of traffic going over the new construction. If the traffic is all confined to the center of the road it is an indication that the gravel is properly spread because traffic naturally goes to that place in the road where it is easiest to get through.

Another method that is productive of equally good results is to deposit the gravel along the shoulders of the road and spread a small portion towards the center. The center of the road is then built up under traffic just as explained in the first method of spreading.

We have found that the method of constructing gravel road just described gives a road with about the proper amount of crown for this part of Iowa. We find that with the flat crown thus produced that all of our material does not become firmly compacted in the road but there is a film of gravel dusting over the road which makes an excellent protection for the road during heavy traffic. It also gives the maintenance man something to work with. As soon as you see a gravel road with all the loose gravel along the shoulders or going into the side ditches it is a very good indication that the road is constructed with too much crown, and the only method I have found for constructing a road that will not have too much crown shortly after it is finished is the one above outlined.

VALUABLE TRADE LITERATURE

(Copies of this literature may be obtained by writing to this magazine or direct to the manufacturers.)

Street Lighting Fixtures.—Education in the intelligent selection of street lighting fixtures is the purpose of Circular 1642, just issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Through its publication, the Westinghouse Company proposes to aid those unfamiliar with street lighting in designating what types of street illumination fixtures are most suitable for conditions under consideration, what the illum-

ination intensity should be and the correct layout to obtain the best results.

The circular, known as "Westinghouse-Cutter Ornamental Posts and Tops," is written in a style that will appeal to the man with little knowledge of the technical details of illumination. It is profusely illustrated with examples of posts and post tops and representative installations of these fixtures are also shown. The growth of the "City Beautiful" idea and the consequent demand for lighting systems of a more ornamental character, eliminating unsightly overhead equipment, have made this publication both timely and useful.

The major considerations in street lighting design, as pointed out in the circular, are the importance of the installation as a safety measure and the enhancement of abutting property values. These, as well as factors of mechanical and electrical design, have to be taken into account before correct specifications can be prepared to secure an ornamental lighting system suitable to a locality.

The circular announces that engineers and others engaged in the preparation of reports and recommendations, covering a complete ornamental street lighting system suitable to various requirements and insuring a maximum of efficiency combined with aesthetic charm, will have at their disposal the Illuminating Engineering Bureau of the Westinghouse Companies which has been organized to carry on research work at the Illuminating Engineering Laboratories at East Pittsburgh, Pa., Bloomfield, N. J., and South Bend, Ind.

Electrically Controlled Valves.—Describes electrical operation of gate valves in water works systems. Issued by Payne Dean, Ltd., 103 Park Ave., New York City. Maintaining water works valves in operating condition is no longer a handicap. Electrification has solved the problem. Many Dean control installations placed in operation during the past few years are successfully demonstrating the practicability of Dean waterproof standardized valve operating units. The Dean motor unit is as rugged as the valve, and may be installed without shutting down the line. From one or more convenient control stations any valve in the system can be readily and easily operated.

Deep Well Pumps.—This is Catalogue B, illustrating and describing Chippewa Steady Stream Deep-Well Pumps as manufactured by the Chippewa Pump Co., Inc., Chippewa Falls, Wis.

Maintaining Roads and Streets. An instructive 30-page booklet entitled, "Modern Methods for Maintaining Roads and Streets," devoted primarily to the many uses of the Andresen Road Repair Outfit, issued by the manufacturers, Littleford Bros., 460 East Pearl street, Cincinnati, Ohio, also illustrates and describes the Littleford line of tar and asphalt heaters, paving tools, etc.

Sand and Gravel Equipment. Illustrates and describes the excavating, elevating, conveying, crushing, screening and washing equipment used in sand and gravel work. Illlstrates plant layouts as well as plant units. An attractive catalog of 60 pages, issued by the Good Roads Machinery Co., Kennett Square, Pa.

Excavator Crane. Pauling & Harnischfeger Co., of Milwaukee, distributed a novel piece of printed matter at the Chicago Good Roads Show. This consisted of 2 discs with an eyelet in the center. The idea back of this novelty was to show why the P. & H. Excavator Crane "8 in 1" machine. By moving the upper disc in a circle the various booms that may be used with the P. & H. appear successively—the standard boom with dragline bucket, boom and grab bucket, with material handling bucket, boom with magnet, boom with backfilling scraper, shovel attachment, skimmer scoop and pile-driving rig. In fact this novelty tells the story without words.

Asphalt Paving Machinery. Folder illustrating and describing the Iroquois line of asphalt paving machinery comprising: mixing plants (portable, semi-portable and stationary), portable steam melting kettles, macadam rollers and tandem roller. Issued by The Barber Asphalt Co., Iroquois Dept., Philadelphia, Pa.

Steel Forms. The Heltzel Steel Form & Iron Company, Warren, Ohio, manufacturers of steel forms for concrete work, are now mailing to all who request it an illustrated comic bulletin entitled, "Steel Forms Talk." In an amusing yet forceful manner the bulletin tells why road contractors should buy Heltzel Steel Forms. Ask for Bulletin 26.

Chimney Losses. Two new bulletins issued by the Uehling Instrument Co., 71 Broadway, New York, entitled, "Magnitude of the Power Plant's Chimney Loss and Relation Between CO2 and Money Wasted Up the Chimney." The subject matter is entirely new and the tables and charts are based on new and representative data.

PAVING TRUNK LINE STREETS

By James C. Blake, Street Commissioner, Worcester, Mass.

To my mind all trunk line streets in cities should be of some kind of permanent paving; and I would say granite block: a 5-in. block on a 5-in. concrete base, grouted, with a 1-in. sand cushion between the base and block.

Granite Block Pavements

Much care should be given to the subgrade to have it properly graded and rolled, to eliminate any soft places, as this part of the work is very essential to a good paving job. It should be given a uniform thickness and a proper mix. The mixture of the base should be 1-3-5, to give the block proper support and to carry the load strain. The thickness of the base should be 5 ins. I would advise the use of a template to make a smooth surface, so that the blocks will lay even and not be up and down, to prevent rocking or moving, when grouted. Also care should be taken to lay the blocks so that the joints do not come opposite each other. In other words, to break the joints properly. This is one of the very important features of good granite block paving. This makes a very smooth pavement.

Great care should be given to the grouting of any block paving, that the joints are properly filled with a mix not too thick, just the right consistency to flow freely and fill every joint from the bottom to top and make a solid bond the full depth of the block. The grout should be a 1 to 1 mix. This is not too rich a mix for good work. Granite block paving done along these lines will wear a lifetime, and I firmly believe that this is the only type of paving that will withstand the heavy truck traffic and load strain that they will be called upon to carry in the next few years, for traffic is increasing rapidly and also the size and weight of load. When one thinks of 18 tons of freight on one truck and the weight of the truck, making a total of about 25 tons passing over our roads and streets, it brings most forcefully to our minds that we must build a heavier, stronger type of paving. Greater care should be given to proper drainage, especially in the rural sections, to prevent frost heaving. John N. Cole, Chairman of the State Department of Public Works,, speaking on roads at a meeting of automobilists in the Hotel Kimball, March 19, 1920, predicted that within 10 years 900 miles of main highways will be built of granite block, 24 ft. wide.

Concrete paving is becoming one of the most popular types of paving that is known for trunk lines, or that portion under State control. Great contracts are being awarded each year, so that at the present time we have miles of this type of paving in every state in the Union. A concrete paving, properly put down, at a proper thickness and with a proper mix, with good drainage and a first-class subgrade, ought to last for many years under the most trying traffic. There are many things entering into the question of paving properly put down: First thickness, uniformity of thickness and mix, width, sub-grade and drainage. The thickness of a good concrete paving should be not less than 10-in., same to be reinforced, although it is a question in my mind as to the essentials of expansion joints. I appreciate the fact that there are many road builders who will differ with me on this particular phase of the question. However, I believe that expansion joints are unessential. Care should be given to the mix, to have it uniform and not to have one batch too wet and the next too dry, for a mix of this kind will not result in a good pavement. Everything going into a good concrete pavement should be measured. Stone aggregate should not be too large. Sand should be clean and sharp so that the mix is right. Care should be given to setting the forms, that they are firm to prevent sagging, using the template to give an even top surface to eliminate waves, etc. The width should be not less than 24 ft., and I would recommend 30 ft. as the proper width, as I think the roads are being built altogether too narrow to take care of the increasing traffic. Roads built ten years ago are inadequate to take care of the traffic of today. A recent study on the state highways of California made by the U. S. Bureau of Public Roads, discloses the average week-day traffic units to be divided in the ration of 97.3% motor driven and 2.7 horse-drawn. A real service is being done in directing public attention, not to the component parts of highway transportation, but rather to the product itself. A comparative statement covering he 11-year period, 1910 to 1921, is indicative of the relative development of these component parts:

	1910	*1921
Automobiles	487,000	8,404,000
Trucks	14,000	1,346,000
Totals	501,000	9,750,000
Maintenance Fund.....	$25,000,000	$180,000,000
Construction Fund.....	95,000,000	420,000,000
Totals	$120,000,000	$600,000,000

* Estimated.

This information is interesting and of value, as what is true in California is true of every other State in the country. Highway design must necessarily be based upon traffic, and the behavior of the various details of design observed under different ranges and types of traffic. Highway transportation is in a condition of flux. An immense growth may be anticipated in the next decade. Our rapidly growing mileage of completed highways, with the prospect of continuous increase each year of construction programs emphasize the urgent need of road information upon which to base sound, economical road building policies, that we may avoid the mistakes and disasters of unwise financial methods and unsound construction policies. The solution of engineering problems of design, maintenance and the like, depends largely upon the character of the traffic, its speed, and the unit loads the highway must carry. The true purpose of an improved highway is a high degree of transportation service at the least possible cost to the public and road user. Clearly a traffic census is not a panacea, but I insist that without a knowledge of the actual traffic, speed, type and weight, of a given area, we are working in the dark. The cities, states and nation have lagged and are way behind in road building while traffic has gone ahead at a tremendous pace. John N. Cole, State Commissioner of Public Works, said it would cost the State of Massachusetts $70,000,000 to widen the roads already built to a safe width.

A very important part of road construction is the sub-grade, as much depends on it. Without a good sub-grade you are sure to have faulty paving, for a machine or a pavement is only as good as its weakest part.

Much is being said about permanent paving, but I have never seen any paving of this kind yet; but there is such a thing as a permanent sub-grade and drainage, and with these two factors permanent it will be easy to build a nearly permanent paving.

Asphalt Pavements

Much can be said in favor of asphalt paving, for many of our trunk lines that take the heaviest traffic are of this type and have been down for a number of years and show no apparent wear. They are built with both the penetration and mixed methods, but I prefer the mixed method. The same care should be taken in this type of paving as in the other two kinds mentioned. In the laying of this paving I would recommend a 6-in. bituminous base, with a 2-in .or 3-in. asphalt top. This makes a resilient pavement that has been able to withstand the heavy blow and load strain of the heavy truck to a marked degree and is well up in the front rank of paving, but this is no new thing in paving, as it was known and used many years before the Christian era. No doubt there have been many changes in the methods of using and applying asphalts, since the early days. It is certain that the mode of transportation has changed most wonderfully.

MURPHYSBORO PAVING BRICK COMPANY

Equal to the Best

"EGYPTIAN" BLOCK

Surpassed by None

MURPHYSBORO, ILLS.

PROMPT DELIVERIES. LET US QUOTE YOU PRICES.

BEST EXTENSIBLE TRENCHING BRACE MADE

KALAMAZOO F'DRY & MACHINE CO. MICHIGAN

594 EAST MAIN ST.

Subscribe for

Municipal and County Engineering

Read and Preserve each copy

Published monthly since 1890.

Two Dollars per year in the United States

Our small size machines are making money for the pit owner with a 100-ton per day market, just as our larger installations are for the car-load gravel shipper. Put your problem up to us.

SAUERMAN BROS.

1142 Monadnock Bldg. CHICAGO

SAUERMAN DRAGLINE CABLEWAY EXCAVATORS

dig, convey, elevate and dump in one operation

ASPHALTIC PAVEMENT CONSTRUCTION IN PROVIDENCE, RHODE ISLAND

New paving constructed by the Department of Public Works of the City of Providence, R. I., during 1921 included 22,584 sq. yds. of sheet asphalt which was laid on both cement concrete and asphalt macadam foundations, and 217,436 sq. yds. of asphalt penetration macadam pavement.

In the sheet asphalt construction a 6-in. cement concrete foundation was employed on the section between the car tracks and in all inaccessible areas which is was believed would not be subjected to very heavy traffic. A 6-in. asphalt macadam base was utilized under that part of the sheet asphalt which was laid between the car tracks and the curb, and on straight stretches where is was anticipated the brunt of traffic would be concentrated. The asphalt macadam foundation consisted of 2-in. trap rock, thoroughly compacted. Texaco Asphalt Cement was applied by four auto-truck distributors owned by the City, and was spread at the rate of approximately 1¾ gals. per square yard.

The large yardage of asphalt penetration macadam was laid on the residential streets of the City of Providence, and is now subjected to a variety of traffic. The work has been so satisfactory that it is planned to lay a still greater yardage during 1922. Texaco No. 96 Paving Cement was the asphalt used.

Contracts Awarded

ROADS AND STREETS

Ariz., Prescott—Warren Bros., Phoenix, awarded contract for impvt. of streets in business section here, at $198,522; Phoenix-Tempe Stone Co., awarded contract for conc. paving on S. Pleasant Ave., at $34,996.

Ark., Pine Bluff—Keliher Constr. Co., Little Rock, Ark., awarded contract for paving 36 blocks

Faultless Service in Every Respect

THAT'S WHAT YOU NEED WHEN TAKING MEASUREMENTS

That's what you can rest assured you are getting when you use

LUFKIN TAPES

PIONEERS IN CONNECTION WITH THE NOTEWORTHY IMPROVEMENTS MADE IN TAPES

More of them are in use than all other makes because they have for years consistently maintained the highest reputation

Send for Catalog No. 26 THE LUFKIN RULE CO. SAGINAW, MICH.

NEW YORK. LONDON, ENG. WINDSOR, ONT.

It "Stays Put"

The Non-Skid Ink Stand

(and Paper Weight)

is of particular value to drawing ink users who work on a slanting drawing board.

It will not slide unless the board is inclined to an angle of more than 27½ degrees.

A cork insert at bottom does the trick, and and make it "stay put."

PRICE, 35c, POSTPAID

$3.50 Per Dozen.

KOLESCH & CO.

138 Fulton Street New York

K TRADE MARK

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

in Linden St. Paving Dist. No. 52; 6-in. rein. conc. with curbs, gutters and storm sewers, 22½ and 30 ft. wide, at $94,387.

Cal., Fairfield—United Construction Co., Vallejo, awarded contract for 6 miles of highway work in Suisun Valley at $127,365. Work will start in spring.

Cal., Oroville—Chico Contracting Co., awarded contract to build Chico-Butte City road; Clark & Henery, Stockton, contract for Oroville-Marysville and Gridley-Lane roads, at $1,800,000 total cost for above named roads.

Cal., Sacramento—F. Rolandi, San Francisco, awarded contract by State Hwy. Comn., for impvt. of section of Yosemite National park lateral from end of present 7-mi. contr. on park side of Mariposa to Briceburg station on Yosemite Valley R. R. and Merced River. Plans call for approx. 6 miles grading, 21 ft. wide. Cost of contract, $177,000.

Cal., Sacramento—Rhodes & Price, Hilts, Cal., awarded contr. for constr. of state hwy. in Santa Clara Co. betw. San Felipe and easterly boundary —about 16.8 miles to be graded, at $195,890; Conners & Hanson, Santa Rosa, awarded contract for constructing state hwy. in Mendocino Co. betw. Forsyth Crk. and Outlet Crk. about 17.3 mi. in length, to be paved with asph. macadam, at $264,-994; J. A. Costello, Jr., San Francisco, awarded contract for constructing state hwy. in Monterey Co. betw. King City and Salinas River, abt. 1 mile in length; one-half mile to be paved with asph. conc. and ½-mile on Dalinas river bridge to be surfaced with asph. conc., at $22,600.

Cal., San Diego—Calif. Constr. Co., 58 Second St., San Francisco, awarded contract to pave portions of several streets in Ocean Beach, at $142,953.

Cal., Santa Cruz—W. A. Dontanville, Hollister awarded contract for constr. of unit 11, 3.9 miles at Chittenden end, in conc., at $81,926; Cowden & Broderick, San Francisco, awarded contract for unit 10, the Boulder Creek end, 3.56 mi., at $67,258.

Conn., Hartford—State Hwy. Dept. let contract for paving 44,000 ft. Dursam Rd. Guildford to F. Arrigoni & Bros., 605 Main St., Middletown, $145,-000; 17,800 ft. Westfield Rd., Granby, to L. Suzio Construction Co., State & Brooks Sts., Meriden, $65,000; 3,800 ft., Litchfield-Torrington Rd., Litchfield-Torrington, to Mascetti & Holley, 561 S. Main St., Torrington, $32,000; 15,050 ft. Litchfield Rd., Goshen, to Ossola & Besozzi, 164 Pythian Ave., Torrington, $42,000; 17,000 ft. Colchester-Norwich Rd., Lebanon, to A. Brazos & Sons, 66 Oak St., Middletown, $50,000; 12,500 ft. Waterbury-Torrington Rd., Thomaston, to C. Vacca, Terryville Rd., Bristol, $58,000; 9,275 ft. Grosvenordale-Mechanicsville cut-off, Thompson, to G. T. Seabury, Inc., 100 Summer St., Providence, R. I., $44,000; 5,000 ft. Quaker Farms Rd., Oxford, to J. E. McGann, Jr., 42 Church St., New Haven, 715,000; 8,400 ft. Sherman Rd., New Milford, to C. W. Blakeslee & Sons, Inc., 58 Waverly St., New Haven, $56,000.

Fla., Bradentown—Finley Method Co., Jacksonville, Fla., awarded contract for constructing about 50 miles of rds., Manatee-Oneco Rd. Dist., asph.; bridges and shell-rut constr.; formed Wyakka Rd. Dist.; constr. 45 mi. rd. from Manatee-Oneco Dist. to De Soto Co. line, at $351,158.

Ga., Atlanta—McDouglas Constr. Co., awarded contract to repave Marietta and Decatur Sts.—Jones Ave. to Yonge St.—1¼ miles, at approx. $200,000.

Ga., Fairburn—Davis Constr. Co., Macon, Ga., awarded contract for constructing 8 miles conc. road from College Pk. to Fairburn; 18 ft. wide, at $200,000.

Ill., Abingdon—Graham-King Constr. Co., 550 So. Cedar St., Galesburg, awarded contract for paving Main, Pearl, Meek and Martin Sts., brick on conc. conc. curbs and gutters, at $150,000.

Ia., Davenport—Geo. Sheldon Co., local, awarded contract for paving 16-mile stretch of road in Missouri, at $400,000.

Kans., Leavenworth—Jas. Stanton & Son., Leavenworth, awarded contr. to lay conc. slab on Section B, Proj. 52, of Fort-to-Fort Rd., Leavenworth Co., at $114,458.

Md., Baltimore—P. Flanigan & Co., 2600 Harford Rd., Baltimore, awarded contract on percentage basis for street paving; also Baltimore Asphalt Blk. & Tile Co., 1320 N. Monroe St., and American Paving & Contracting Co., Montebello, at total cost of about $200,000.

Mich., Bessemer—W. S. Peters, Wakefield, awarded contract for improving 9 miles road in Wakefield Twp., at $112,755.

Minn., Little Falls—Following contracts let for St. Road Projects: 27-22, FAP 254, 10 miles and St. Proj. 27-01, FAP 264, 5 miles: Paving to McCree, Moos Co., 711 Mer. Natl. Bk. Bldg., St. Paul, 165,000 sq. yds. conc., at $345,000; Grading, M. Barrett, St. Cloud, $11,220; Culverts to Russell Grader Co., 2005 University Ave., SE. Minneapolis; Installing culverts to A. B. Peterson, Little Falls, Total $350,030.

Minn., Minneapolis—General Constr. Co., 1228 Plymouth Bldg., Minneapolis, awarded contract for 8 miles paving bet. Robbinsdale and Hamel, at $353,313; bitulithic to be used.

Miss., Ashland—F. D. Harvey, Memphis, awarded contract for bldg. 30 miles government road no. and so. thru County, at $198,000.

Mo., Eminence—Cooper's Constr. Co., St. Louis, Mo., awarded contr. to construct 4.006 miles State Rd. from Winona eastward and westward; grading excavating, constructing draing. structs., etc., at $119,087.

Bids April 21, 1922.

STREET IMPROVEMENT

Winchester, Ky.

The Board of Commissioners of the City of Winchester, Ky., will on April 21, at 2:00 P. M., in its Chamber at the City Hall, received sealed bids for the improvement of about 30,000 sq. yards of streets, to be constructed of Asphalt, Vitrified Brick or Concrete, according to the plans and specifications therefor on file in the office of the City Clerk or City Engineer.

The Commissioners reserve the right to reject any and all bids.

N. A. POWELL,
Commissioner of Public Works.

Neb., No. Platte—Abel Constr. Co., Lincoln, awarded contract for paving 40 blocks of streets here at approx. $200,000.

N. J., Cape May—Sutton & Corson, Ocean City, awarded contract for paving State Hwy. Route 14, Sec. 5, Cape May Court House-Swainton, at $118,-776.

N. J., Hackensack—J. Kinzley, 65 Hudson St., awarded contract for paving 2 miles Sec. I-B, St. Hwy. Route 10, 91% engr.'s est., $94,875.

N. J., Mays Landing—C. H. Earle, 173 Main St., Hackensack, awarded contract for reconstructing 41,752 sq. yds. Smithville-Mullica River, (Sec. 9) Ocean Hwy., St. Hwy. Route 4, bitulithic, at $374,533.

N. J., Salem—Masterson Constr. Corp., 15 E. 40th St., New York, awarded contract for reconstruct-70,328 sq. yds. Route 6, Sec. 10, Quinton-Marlboro, gravel, at $79,793; J. T. Burke, 309 Park Ave., Plainfield, awarded contract for 29,847 sq. yds. Route 6, Sec. 11, at $111,833.

N. J., Woodbury—M. Staub, Swedesboro, awarded contract for reconstructing state hwy. route 6, sec. 6, Oldmans Crk. to Mullica Hill, rein. conc., at $203,660.

N. Y., Mayville—J. S. Hart, Westfield, awarded contract for 4.5 mi. road bet. So. Dayton and Smith Mills, at $119,348; T. Fitzgerald, 89 Glisan St., Fredonia, awarded contract for 1.91 mi. rd. in Cassadago, at $57,800—both concrete.

N. Y., Albany—State Hwy. Comn. let following contracts: Impvt. of 3.25 mi. Hwy. 1562, Albany Co., to L. Mayersohn, 6 Catalpa Dr., Albany, at $85,466; 0.73 mi. Hwy. 1608, Broome Co., to Stento & Serafini, 74 Court St., Binghamton, at $46,160; 5.73 mi. Hwy. 8087 Cayuga Co., to Pathfinder Constr. Co., Inc., Fulton, at $179,995; 7.9 mi. Hwys. 5669 and 8088, Clinton Co., to Smith Bros. Constr. Co., Cleveland Bldg., Watertown, at $240,655; 3.79 mi. Hwy. 8086, Erie Co., to Wieberg Bros., Forks, $117,824; 8.41 mi. Hwy. 8089, Genesee Co., to E. J. Bailey, Brocton, $268,677; 8.5 mi. Hwy. 8090, Herkimer Co., to P. Morford and C. J. Nitsch, Fultonville, $243,075; 1.06 mi. Hwy. 5667, Montgomery Co., to J. B. Fazlo, 4 Leonard St., Oneida, $57,765; 2.25 mi. Hwy. 1607, Orleans Co., to Sweeney and Boland, Rochester, $43,244; 4.14 mi. Hwy. 1609, Schenectady Co., to J. J. Bellotte & Son Constr. Co., Troy, $129,674.

N. Y., Holley—Sweeney & Boland, Rochester, awarded contract to improve second section of Clarendon-Byron Rd. in Orleans Co., two and a fraction miles in length, at $43,243; Ernest J. Bailey, Brocton, awarded contr. to improve Batavia-Bergen Rd., Genesee Co., at $266,677.

N. C., Raleigh—Following contracts let for road construction: 2½-mile stretch from Asheville to Craggy mountain, hard surfaced, to C. W. Lacy, Wilmington, at $95,583; B. C. Stevens, Asheville, contr. for bldg. the structures, at $6,109; R. H. Wright & Son, Asheville, contract for constr. of 12 miles waterbound macadam from Sylva to So. Car. line, at $23,430; structs. on proj., to W. T. Moore Conc. Products Co., Andrews, at $37,710; 4½ mi. gravel rd., Caldwell Co., let to Caldwell Co. Comn., at $24,448; brdgs. to R. M. Thurston, Lynchburg, Va., at $22,620; 6 mi. Polk Co., Columbus to So. Car. line, hard surfaced, to Southern Paving Co., Chattanooga, Tenn., at $195,469; brdg. work to Henry Constr. Co., Greenville, at $19,897; O'Brien Constr. Co., Birmingham, awarded contract for 14 mi. waterbound macadam from Franklin to Georgia Line, Macon Co., at $111,135; brdg. work to Griffith Constr. Co., Salisbury, Md., at $33,113.

N. C., Shelby—Asheville Paving Co. awarded contract for approx. 8 mi. Topeka asph. street paving, at $248,860.

Ore., Salem—E. A. Webster & Co., awarded contr. of Hood River Booth hill sect. of Mt. Hood Loop Hwy., at $114,392. Job includes 6.1 miles grading; Johnson Contracting Co. awarded contract for grading 12.1 mi. Mt. Hood Loop Hwy. known as Booth Hill-Forest boundary sect., at $74,121.

Ore., Salem—Following contracts, aggregating $400,000, let by St. Hwy. Comn.: Porter & Conley, grading 4.85 mi. and rock surfacing 24.09 mi. Nelson-Malheur Co. line sec. Old Ore. Trail, at $108,-892; Solheim & Gustafson, paving Youngs Bay-Skipanon sec., Roosevelt Hwy. unit, 10.33 mi. conc. at $9,788; unit 2, 4.20 mi. bitum. to J. H. Tillman, $100,775; Solheim & Gustafson, grading and rocking .9 mi. thru Rainier, at $18,006; Marsh & Bauers, rock surfacing 15.54 mi. Weiser-Baker Co. line section Old Oregon Trail, at $68,100; Porter & Conley, rock surfacing 18.77 mi., Kamela-Ora Dell sec. Old Oregon Trail, at $79,685; Union County brdg. across Grande Ronde river and one over Dry Creek on La Grande-Joseph Hwy. to Union Brdg. Co., at $30,747.

Pa., Harrisburg—Following contracts let by State Hwy. Comn.: Clearfield Co., Pike 8217 ft., Burnside Constr. Co., Cresson, at $81,392; Knox, 16,812 ft. Burd Constr. Co., Cresson, at $146,054; Osceola Mills, 2,432 ft. Gifford & Pritchard, Philipsburg, $27,304; Sandy, 6,954 ft. W. C. Guncheon, Smethport, $52,122; Bradford Co.—Canton & Lorory, 34,432 ft. to A. W. Hinaman, Akron, O., $23,923; Athens Twp., 10,500 ft. Horn & Devling, Galeton, $80,329; Smithfield & Ulster, 37,712 ft. Horn & Devling, $291,758.

Pa., Phila.—M. J. McCrudden, Real Est. Trust Bldg., awarded contr. for paving Kensington Ave., from Ontario to Frankford Aves.; granite block, at $84,786.

Pa., Port Allegany—Clark Bros. Constr. Co., Hastings, Pa., awarded contract for road constr. in Blair, and Center Cos., at $371,367; Kavanaugh-Deniro Constr. Co., Youngstown, O., contract for road wk. in Clarion Co., at $211,049.

Pa., Pottsville—American Paving Co., Chester, will likely be awarded contract for street paving here at $183,000. Recent resolution rescinding contract will be reconsidered and contractors given mandate to go ahead with the work immediately. Asphalt adopted as material.

Tenn., Athens—Coker, Gamble & Brown, Chattanooga, Tenn., awarded contract to pave streets at $80,000.

Tenn., Memphis—Bryant Paving Co., Waterloo, Ia., awarded contr. by Bd. Commrs. for 28,700 sq. yds. sheet asph. and necessary draing. and grading, at $150,000.

Tex., Coleman—Burke & Hart, awarded contract for grading and surfacing; McCall-Moore Engrg. Co. the contr. for draing. work on 23 miles of rd. leading from Coleman to the Callahan Co. line near Cross Plains, at $250,000; Burke & Hart also awarded contr. for Brady road—5.14—100 mi. to Precinct No. 1 line, at $25,250.

Tex., Dallas—City let contr. to Texas Bitulithic Co. at $137,013 for paving S. Lamar St., at $137,013.

Tex., Dallas—Rawhide Paving Co., awarded contract for paving 30 miles Dallas Co. Belt Line road, at $8,000 per mile.

Tex., Livingston—Tibbets Constr. Co., Mineral Wells, Tex., awarded contract for constructing 10.31 miles St. Hwy. No. 35; gravel; $250,000 available.

Tex., Marlin—Hess & Skinner, Dallas, awarded contract for constr. of 26 miles road in Falls Co., Precinct 5, at $126,884.

Wis., Fond du Lac—Frank Doherty Co., Milwaukee, awarded contr. for Brandon-Ladoga job which calls for 16-ft. conc. hwy. 6.11 miles to Ladoga, at $112,154; Lampert Constr. Co., Oshkosh, contr. for Ripon-Rosedale Rd., 18-ft. conc. rd. from 3 miles east of here and extending 5.94 mi. along S. T. H. 23 to Rosendale, at $128,047; Froeming Bros., Inc., Milwaukee, awarded contr. for Fond du Lac-Eden job, 18-ft. hwy. 7.04 miles in length, at $141,127; Widell Constr. Co., Mankato, contr. for Waupun rd. job, 18-ft. conc. hwy., 12.42 miles southwest along S. T. H. N. 31 to city limits of Waupun, at $259,270; Brogan & Schaefer Co., Green Bay, contr. for Kewaskum-Waucousta proj., at $114,824—18-ft. hwy. 4.88 miles.

Wis., Marshfield—Wausau Iron Works, awarded contract for Senaca-Corners job, which includes link of Senaca with conc. toward Arpin on 13, and 3 miles west of Senaca on Wiscons Rapids-Bettsville rd., a total of $172,049, exclusive of cement which is to be furnished by the county; Larson Constr. Co., Eau Claire, awarded contract for constr. of Blenker-Milladore rd., at $1.93 per yd.

Wis., Racine—Brennan & Bounsall, Kenosha, awarded contract for Racine-Thompsonville rd., at $128,046.

Wis., Waukesha—Morris Martin, Berlin, awarded contract for impvt. of Templeton-Merton Rd., at $76,548; Waukesha-Wales Rd. to J. R. Griffith, Racine, at $148,291.

Wis., Waupaca—Joe McCarthy, Kaukauna, awarded contract for constr. of Clintonville-New London Rd., FAP 138, at total of $100,497.

Wis., West Bend—Geo. M. Gross, Appleton, awarded contract for FAP 304, at $163,543.

SEWERAGE AND SEWAGE TREATMENT

Ark., Pine Bluff—Geliher Constr. Co., Little Rock, Ark., awarded contract for storm sewer and paving in Linden St. Dist. 52, at $94,387.

Cal., Banning—R. E. Garretson & Co., 1346 Fairfax Ave., Los Angeles, awarded contract for storm sewers in Gilman & Indian Canyons, at $31,856.

Cal., Santa Monica—Joe Chutuk, 425 Bullard Bldg., Los Angeles, awarded contract for impvt. of Penn. Ave.—14th to 20th Sts.—at $65,048.

Cal., Watts—B. D. Baucus, 173 W. 43rd St., Los Angeles, awarded contract at about $484,000 for constr. of sewer system, including treatment plant for city.

Ill., Granite City—R. B. Higgins Constr. Co., St. Louis, award contract for completion of the outlet sewer at $300,000.

Ill., Winnetka—Gaedke & Donovan, Waukegan, awarded contract for san. sewers and water system, at $75,000.

Ia., Clarksville—Following contracts let for sewer system here: sewer pipe to Kruse Constr. Co., $33,518; disposal plant to H. E. Wilcox, $5,137.

Ia., Davenport—Matthes Coal & Constr. Co., Davenport, awarded contract for san. sewer in Duck Creek Dist. No. 11; 316′ 24 to 42″, 1 pumping sta., at $163,000.

Mass., Boston—S. J. Tomasello awarded contract for sewerage works in Sever St.—Haverhill to Kingston St., Charlestown, at 0898; C. & R. Constr-Co. contract for bldg. Dorchester brook sewer in Norfolk Ave., from about 240 ft. northwest of Franklin Court to E. Cottage Dorchester, at $32,522.

Mich., Detroit—For: (1) Woodward Ave. Arm of 7-Mile Rd. Sewer (2) Dequindre Ave. Arm of 7-Mile; (3) Coon Ave. Arm west of Wyoming Ave. sewer; (4) Joann Rd. arm of Gratiot Ave. sewer; (5) Buena Vista Arm of Wyoming Ave. sewer; (6) Fenelon Ave. arm of Lynch Rd. sewer; (7) Livernois Ave. arm of 7-Mile, to C. R. Lennane & Co., 2631 Woodward Ave., (1) $31,614; W. Blanck & Co., 827 Ford Bldg.; (2) $104,431; (3) $26,973; (4) $48,876; (6) $30,682; G. R. Cooke, 1260 Penobscot Bldg.; (5) $23,086; C. M. Davis Co., 400 Penobscot Bldg.; (7) $72,782.

Mich., Northville—Sgullo Constr. Co., Akron, O., awarded contract for 25,800 ft. 8 to 18 in. main san. sewer, Sec. 1 and 24, 300 ft. 8 to 12 in. Sec.

2, at $34,415 and $26,005 respectively; sewage treatment works, Imhoff tank, etc., to Denton & Johnson, Saginaw, at $34,750.

Minn., New Ulm—Rahr & Pratt, Pipestone, awarded contract for storm and san. sewers at $28,569; water impvts. to Feyen Constr. Co., 277 Burgess St., St. Paul, at $5,818.

Mo., Springfield—R. McSweeney, Springfield, awarded contract for storm sewers at $300,000.

N. Y., Brooklyn—A. M. Hazell, Inc., 26 Cortlandt St., New York, award. contract for remodeling sewer outfalls, Sec. 2-B, Biological Plant, 26th Ward Disp. Wks., at $96,121.

N. Y., Rochester—J. Petrossi Co., 701 Elwood Bldg., awarded contr., for 8,000 ft. 6-7 ft. conc. invert relief tunnel from Railroad to Main Sts., Main to Goodman Sts., Goodman to Webster Sts., and Webster to Bay Sts., with 800 ft. segmental blk., at $250,956.

O., Canton—Garaux Bros., 735 Market St., S. awarded contract for san. sewer in 12 blks. Wertz Ave.,—Tuscarawas St. W. to 12th St. N. W., etc., at $30,000.

O., Lakewood—Jos. & Kalill, 502 Huron Sq. Bldg., Cleveland, award. contract for sewer and water mains in Berea Rd., at $52,249.

O., Zanesville—E. & W. McShaffery, Akron, O., awarded contract for miles vit. pipe sewer here in Southwestern Sewer Dist., at $66,520.

Ore., Portland—J. F. Shea, awarded contract to build Oregonian Ave. sewer, at $51,668.

Wyo., Casper—Gordon Constr. Co. awardede contract for constr. of san. sewer in Dist. 10, at $7,722.60 if paid in cash and $43,678 if paid in bonds.

WATER SUPPLY AND PURIFICATION

Ark., De Queens—Campbell & Hengst, Dallas, awarded contract to construct water works, at $56,000.

Ia., Manning—W. B. Carter, 606 United Bank Bldg., Sioux City, and Bessemer Gas. Eng. Co., Omaha, Neb., awarded contract for pump house, 2 engines, 2 pumps, 1 well and 1 oil tank, at $17,995.

Mo., Graham—Pittsburgh-Des Moines Steel Co., Tuttle & Southwest 10th Sts., Des Moines, Ia., awarded contract for 4-6 in. mains, at $25,000.

N. Y., Brooklyn—Knight & De Micco, 448 E. Tremont Ave., New York, awarded contract for mains and appurts. in Shore Blvd., Ocean Ave., Manhattan Beach, Highland, Laurel, Poplar, Manhattan, Mermaid, Seagate and Surf Aves., Beach 38th and Beach 40th Sts., at $41,004.

N. Y., Long Island—Dominick Constr. Co., 246 Bowery, New York, awarded contract for mains and appurts. in Van Alst, East and Nott Aves., 1st Ward here, at $71,925.

N. Y., Newburg—Mapes & Erway, Warren, O., awarded contract for mech. filter plant, consisting of piping, drains, equipt. connections and appurts. of head house and filter house, etc., at $192,833.

N. Y., New York—Caldwell-Wilcox & Co., Newburgh, awarded contr. for furnishing and delivering gate valves, steel castings and appurts., for steel pipes of Catskill Aqueduct, f. o. b. at designated localities in Ulster, Orange, Putnam and Westchester Cos., at $36,170.

N. Y., St. George, S. I.—J. McAvoy, Jr., 313 E. 127th St., New York, awarded contract for hauling and laying mains and appurts. in Arthur Hill Rd. here, at $51,834.

N. C., Ayden—Robt. G. Lassiter & Co., Norfolk, Va., awarded contr. to extend water and sewer systems at $195,000; also pave streets.

N. C., Littleton—Bacon & Moore, Norfolk, Va., awarded contract to construct water, sewerage and electric light systems, at $96,000.

N. C., Winston-Salem—Porter Plumbing Co. awarded contract by Pillot Real Estate Company for constr. of 1½ miles water and sewer systems in Buena Vista Annex, at $18,000.

N. D., Fargo—Will remodel, repair and build addn. to filtration plant by Day Labor at cost of about $40,000. R. T. Johnson, City Engineer.

O., Delaware—Burgess & Niple, 141 E. Broad St., Columbus, awarded contract for bldg. and equipping softening and filtration plant, at $72,000.

Okla., Hobart—Ajax Constr. Co., Okla. City, awarded contract for constr. of water system and making certain addns. to sewer system, at $106,567.

Tex., Groesbeck—James Contg. Co., Southland Hotel, Dallas, awarded contract for water and sewerage systems, at $92,000.

Tex., Munday—Jones Construction Co., Dallas, Tex., awarded contract to construct water works, at $44,000; install 55,000 gal. tank elevated 100 ft. with 6 and 8-in. mains.

Wn., Puyallup—Troutman & Co., Seattle, awarded contract for replacing old wooden mains with cast iron pipe, at $15,690.

Wis., Milwaukee—J. B. Forrestall Co., 215 15th St., awarded contr. for mains in various streets, at $46,622.

Wyo., Greybull—Johnson & Cotner, Worland, awarded contr. for 200,000 gal. steel tank, 28, 30 ft. 2-8 in. mains, hydrants, valves, fittings, etc., at $50,609.

Prospective Work

ROADS AND STREETS

Ala., Birmingham—City Comn. will expend $123,425 to improve sts.; pave 2nd Ave. thru to Tuscaloosa, at cost of $73,575; 24th St.—7th Ave. to 24th Sts., railroad crossing, asph. over 5-in. conc. base, $5,275; 8th Ave.—4th St. to west line Owenton survay; sheet asph. with 50-ft. rdwy extending over conc. base at $44,575.

Ala., Birmingham—City and Jefferson Co. will construct connect'g. roads within city limits, including Pratt City-Birmingham Rd., So. Bessemer connection, Fairfield-Fairview road, Mt. Pinson road and Woodlawn-Gate City road; 20-ft. hwy. of perm. paving; County will pay $325,000 and city $175,000. A. J. Hawkins, Chf. Engr. Claude A. Rogers, Co. Engr. Jefferson Co. Bd. of Revenue will also construct Ensley-Mulga-Edgeward-Wylam loop with extension to Parkstown 12 mi.; bitum. top on reconstructed base, $275,000; Warrior-Robbins Cross roads, 10 miles; chert, $75,000; Elbow to Port of Birmingham, 12 mi.; chert, cost $60,000; Trussville road to county line; chert; $50,000; grade Overton loop to Mims by filter plant, 5 miles, cost $40,000; Bradford-Trafford roads, 6 miles, graded highway, $50,000—total cost $550,000. Will ask bids. Claude Rogers, Co. Engr.

Ark., Eldorado—City has formed 8 Impvt. Dists. Plans to pave 43,000 ft. hard surface pavement.

Conn., Milford—Plans paving E. Broadway, Ft. Trumbull Beach, $86,000; North St., $16,700; Broad St., $10,000; Hillside Ave., $14,500; Gulf St., $15,000; Daniel St., $3,800; West River St., $10,000.

D. C., Washington—Dist. Commrs. will improve Ninth St., Dupont Circle, P and R Sts. at cost of $60,700.

Fla., Ft. Lauderdale—Broward Co. will construct roads, including widening and rebldg. Dixie Hwy. 26 miles. $600,000 available. F. A. Bryan, Clk. Co. Commrs. H. C. Davis, Engr.

Fla., Jacksonville—City Comn. authorized advertisement for bids for impvt. of 5 streets; brick on conc. on Adams St.; brick on sand on First St.—Evergreen to Florida Ave.; and asph. on conc. on portions of Margaret St. Hogan and King Sts.

Ga., Atlanta—Fitzhugh Knox Real Est. Co. will construct streets in 65-acre site to be developed.

Ga., Oakland—Realty Sales Corporation will grade and pave streets in 100-acre site to be developed.

Ga., Rome—Floyd Co. and State Hwy. Comn., Atlanta, Ga., will construct 5½ miles Summerville Rd. from Armuchee to Chattanooga Co. line. For detailed information address Bd. of Rds. & Revenues, Rome or State Hwy. Comn, Atlanta.

Ill., St. Charles—Council passed Ord. for paving Geneva Rd. As soon as court proceedings are finished bids will be advertised.

Ky., Williamstown—Grant Co. voted $250,000 bonds for completing concrete highway extending from Covington to Scott Co. line.

La., Donaldsville—Ascension Parish will construct roads in Third Road Dist., New River Section. Voted $100,000 roads.

Minn., Elbow Lake—Bids will soon be asked for graveling state road 3; 5 miles. Survey will be made of Elk Lake St. Rd. from Barrett E. to co. line. State Rd. 8 will be graveled. W. E. Burgess, Co. Hwy. Engr. C. M. Nelson, Aud. Grant Co.

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Texas Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill & Ferguson.
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Morse, Wm. F.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Disinfectants.
Integrity Chemical Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Mo., Chillicothe—City Council has approved City Engr's. plans for resurfacing with Tarvia portions of Webster, Vine, Monroe and 2 blks. on Irving Ave.

N. Y., Albion—Orleans Co. soon to advertise for bids for paving 2.36 miles Albion-Eagle Harbor Rd., $30,000; 2.6 mi. Knowlesville-Ridge Rd., $38,000—both concrete. H. D. Waldo, Co. Supt.

N. Y., Dansville—$60,000 bonds voted to pave Lackawanna Hill Rd. J. Stiegler, Pres.

N. Y., Ellicottville—Will soon take bids for completing roads now under constr. and new 4 mile road bet. here and Ashford, $60,000.

N. Y., Geneva—Bd. of Public Works soon opens bids for paving Pultney, Grove and High Sts., Nursery and Lafayette Aves.; asph., $145,256; conc., $149,083; brick and conc. $181,019.

N. Y., Holley—Orleans County considering paving 2.5 miles Kendall-Morton Rd., 16 ft. concrete. Est. cost $36,000.

N. Y., LaSalle—May pave River Road. Est. cost $45,000.

N. Y., Medina—$38,000 bonds voted to pave West Ave. C. H. Pettis, Pres.

N. Y., Warsaw—Board of Supervisors, Wyoming Co., has approved plans, specfs. and estimates of cost of Wyoming Village-Ridges Corners improved highway and has appropriated the $22,000 which is county's share of cost of impvt. Est. cost of highway is $65,000. Distance is .89 mile; is to be conc. street 18 ft. wide, and portion within built up section of village is to be widened to 30 ft. with curbing, etc.

N. D., Carrington—Following road work considered. E. road to 10 miles east of city to be graveled. F. A. Road to be established from Melville to Carrington. E. K. Scheaefer, Co. Aud. Foster Co.

Ore., Portland—$11,000,000 will be expended by State Hwy. Comn. on road work. Program calls for completion of nine important thoroughfares. 6 million are for work to be let, $5,000,000 for work under contract or commitment; 6 million includes $1,500,000 due from counties and $2,000,000 from government. The $2,500,000, set aside for Roosevelt Hgy. calls for co-operation with Fed. Gvt.

Tenn., Dyersburg—Ords. passed for paving three streets with asphalt.

Tenn., Knoxville—City may advertise for bids in near future for paving portions of about 9 streets.

Tex., Georgetown—$100,000 bonds voted for street paving and fire equipment.

Tex., Beaumont—Jefferson Co. Commrs. Court will construct 45 mi. conc. road and 90 miles shell roads; build bridge; cost $2,000,000. A. C. Love, Co. Engr.

Tex., Tyler City—H. J. Graeser, in charge, will construct ½-mile paving; 8-in. rock base or bitum. top. $20,000. Constr. by city forces.

W. Va., Wheeling—30 miles of country roads will be rebuilt by County this spring because of road constr. undertaken by state on National pike. Co. Engr. Alex. Hoffman has made estimates of various projects.

Wn., Aberdeen—Petitions filed for grading and graveling W. 7th St. impvt. of Fairview Blvd. and 25 blks. in circumscribed area in Broadway Hill district. East Second street will be improved. Several other streets in South Aberdeen may be filled and improved.

Wash., Yakima—C. H. Cecil, dist. forester, announces that Stevens Pass will be improved this yr. from east portion of Cascade tunnel to Merrit, 17 miles; Kittitas Co. sect. of Blewett Pass road will be finished; 11 miles Blewett Pass rd. in Kittitas Co. will be finished at cost of $150,000 to $200,000. It will be graded and graveled. In addn., Chelan Co. will expentd $45,000 on northern end of Blewett Hwy.

Wis., Medford—Plans prep. for 16,000 sq. yds. conc. paving on Wisconsin Ave., Main, Whelan, State and Divisions Sts. S. P. Hall, Engr., Ingram Blk., Eau Clairs. H. Maurer, City Clk.

Wis., Wausau—Will pave 10,500 sq. yds. reinf. conc. integral curb on Clarke, Callon and W. Washington Sts. B. C. Gowen, City Hall, Engr., F. N. Blecka, City Clk.

SEWERAGE AND SEWAGE TREATMENT.

Cal., San Bernardino—City Engr. C. E. Johnson has issued petitions for approx. 2½ mi. sewer work covering northeost dist.

Ont., Eastview—City plans constr. of 3 miles sewers in Montreal Rd. and several streets at cost of $52,000. L. S. Abbott, 410 Weston Bldg., Engr.

Colo., Colo. Springs—City Council has requested City Atty. to draw up resolution creating storm sewer draing. dist. on west side. This is 1st step toward installation of storm sewer sys. which will cost prop. owners total of $74,000.

Ill., Dixon—Plans being prepared for 10-14 in. vitr. tile sewers here. $27,000 est. cost. D. N. Clayton, Engr. City Hall.

Ill., Waukegan—Sewage disposal plant costing upwards of $160,000 will be constructed here in near future, according to plans being made by North Shore San. Dist.

Mich., Detroit—City considering 1191 ft. Clark Ave. sewer, Sec. 1, in Summit Ave.—Jefferson Ave. thru Riverside Park to Harbor line, 7 ft. 6-in. x 8 ft. 8-in., 4 ft 6-in. cylinder connections, rein. conc. and brick; Martin Ave. sewer in Martin Ave.—Pittsburgh Ave. to 1247 ft. no., rein. conc. vit. segment blk. brick or monolithic conc., 4 ft. cylinder. C. W. Hubbell, City Engr.

Mich., Kalamazoo—Plans being prepared for sewer in Dunkley, Birdick, Millview, Stockholm, Fair, DeWitt and Eggleston Sts.; 10,000 ft. 18, 20, 24, 30 and 54 in. pipe, $140,000 bond issue approved. E. S. Clark, City Engr.

Minn., New Richland—Plans under way for san. sewerage system at cost of $30,000. L. P. Wolff, Engr., 1001 Guardian Life Bldg., St. Paul.

Mo., Joplin—Ords. passed by City Comn., establishing Shoal Creek sewer districts Nos. 3 and 4 and ordering constr, of public santitary sewers in the districts. Ests. on projects submitted by S. P. Ashcraft, City Engr. There are to be 1686 lin. ft. sewere pipe in sewer to be laid in alley bet. Main and Joplin Sts. and 1920 lin. ft. in

Mont., Glendive—City will construct storm sewers throughout City this Summer; also relay water mains, $50,000.

Neb., Grand Island—City Council has called election to vote on sewer bond issue in sum of $300,000—$200,000 being for sanitary sewerage and $100,000 for storm sewers.

Neb., Lyons—Plans under way for complete san. equipt. and sewer, $50,000. Frank Fulton & Letton, Engrs., 505 Bankers Life Bldg., Lincoln.

N. Y., Binghamton—Plans san. sewers in 12 streets and storm water sewers in 2 streets. Cost will exceed $25,000. W. E. Weller, City Engr.

N. C., Asheville—City planning installation of additional sewer and repair of old ones. Will issue $100,000 bonds. H. J. Sherrill, Commr. Pub. Wks.

N. C., Conover—City plans sewer and water works system at cost of about $50,000. Spoon & Lewis, Engrs., Greensboro, N. C.

N. C., Lumberton—Town Commrs. will extend sewer and water systems; will issue $120,000 bonds.

N. C., Mt. Airy—Town Commrs. plan to sell $75,000 bonds for instalaltion of sewerage system.

N. C., Roxboro—City contemplates installing sewer system at cost of $40,000. Spoon & Lewis, Engrs., Greens boro, N. C.

N. C., Winston-Salem—City plans expendt. of $200,000 to install sewer and water systems in Southside. H. L. Shaner, Commrs. Pub. Wks.

Ohio, Port Clinton—W. H. Ditto, Columbus, State Engr. met with Port Clinton Council to discuss sewer impvts. planned for City. Temp. impvt. is to eliminate depositing sewage in Lake Erie at Fulton and Depot Sts. and place temporary branch sewer along First St. to river.

Okla., Wilburton—$201,000 carried at election here. Funds will be spent for san. sewer system, impvt. of light plant and purchase of fire fighting equipt.

Tenn., Memphis—City will improve and extend sewer system; will issue $150,000 bonds.

Tenn., Ridgely—Town will construct sewerage sewerage and water systems, for which $60,000 bonds have been issued.

Tex., Port Arthur—City will extend sanitary and storm sewers; 6-in. to 36-in. vit. pipe and conc. pipe. Nagle, Witt & Rawlins, Cons. Engr.

Tex., Weatherford—$25,000 bonds sold for sewer extensions. G. Parker, City, Engr.

Va., Petersburg—City plans expending from $25,000 to $30,000 to construct 30-in. sewer. Louis Brownlow, City Mngr.

Wn., Tacoma—Plans comb. san. and storm trunk sewers (rein. conc.) in part of west end, south side, all of S. Tacoma and Manitou, 6 miles long. $1,000,000.

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric .
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Hydrants.
The Flower Company.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machinery Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers, and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Muhicipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Wis., Oshkosh—City plans 6-12 in. vitr. storm and san. sewers in various streets at cost of $35,000. G. W. Randall, City Engr.

WATER SUPPLY AND PURIFICATION.

Ala., Birmingham—Birmingham Water Works Co., plans increasing capital from $2,529,700 to $3,029,700 for plant impvts; erect plant additions; extend water supply pumping and purification equipt.; distribution system; services, meters, etc.

Ark., Fort Smith—City plans to improve water works; improve distribution system; construct additional mains and cross feed lines; 3,000,000-gal. reservoir on Crow's Hill, etc. E. Kiersted, Cons. Engr., Kans. City, Mo.

Ark., Springdale—City will improve works; lay 2 mile pipe to Stultz Spring; install elec. pumping station. Purchased additional site.

Cal., Moorpark—$25,000 bonds voted here for water system and Engrs. F. G. Dessery and E. R. Bowen, Central Bldg., Los Angeles, selected as Cons. Engrs.

Alta., Coleman—Constr. of water works system to serve West Coleman is being considered. By-law will be submitted.

Ont., Galt—Mgr. W. H. Fairchild, Pub. Utilities Comn., preparing report on proposition to lay water main across river to feed east side of city.

Ont., Long Branch—Petition signed by practically all residents will be presented to Etobicoke Twp. Council, urging creation of water area here and immediate installation of water system.

Ont., Niagara-on-the-Lake—Michigan Central Ry., 15th St., Detroit, Mich, having plans prepared for 4-in. mains and new standpipe here. Est. cost $35,000. A. Leslie, care Mich. Cent. St. Thomas, Engr.

Ont., Smith's Falls—Town Council served with writ at instance of Provincial Bd. of Health, for non-compliance with order for installation of filtr. plant.

Que., Quebec—Power given to Que. Streams Comn. to build gigantic dam on Quarea River, Laurentian Mountains, beyond St. Agathe, at cost of $250,000. Work will be started in Spring and will include erection of storage dams at Lakes Quarea, Archambault and Blanc.

Fla., Seabreeze—City wil install water works; $55,000 bonds voted.

Fla., Quincy—City considering constr. of hydro-electric plant to cost about $175,000. J. P. Smith, City Clk.

Ill., Hinsdale—Bids will be received about June for constr. of 6-8-in. cast iron mains. $25,000. E. Hancock, Engr., 2047 Ogden Ave., Chicago.

Ill., La Salle—Making plans for laying 4-6 in. cast iron mains. $25,000. E. Byrne, City Hall, Engr.

Ky., Newport—City will take bids within 90 days for new 6-million gal. pumping engine. Est. cost $150,000.

La., Houma—$200,000 bonds voted for water and purification plant and electric lights.

Mich., Port Huron—Plans prepared for new intake well, also 2 intake pipe lines 30 in. diam., extending 150 ft. into St. Clair River. $15,000. Work will probably be done by day labor under direction of D. D. Worcester, City Engr.

Minn., Sauk Centre—Plans under way for extension to water works. J. E. Cooper, Vil. Clk. Engrs. L. P. Wolff, Guardian Life Bldg., St. Paul.

Neb., Columbia—City contemplates installing new storage tank, 250,000 gals. H. R. Robertson, Mgr. Ltg. Co. interested.

Neb., Ogallala—Plans completed for constr. of large reservoir at head of S div. canal at Ovid, Colo., to carry water to reservoirs on table land in Keith and Perkins Cos. Hydro elec. power is contemplated. Keith, Deuel & Perkins Cos. Irrg. Assn. Jno. Schwin, Ogallala, Pres.

N. Y., Scottsville—Plans being made for water and sewage disposal system, including pumping station, standpip, filtr. plant, etc. $100,000.

N. C., Conver—City will construct water works system; install wells, pump, motor, tank, hydrants; about 2¾ miles 4-in., 6-in. and 8-in. cast iron mains; motor driven plunger pump 150 gal. per min., 160 ft. head; 75,000 gal. tank on 90-ft. tower, cost abt. $35,000. Spoon & Lewis, Cons. Engrs., Greensboro, N. C.

N. C., Lumberton—Town Commrs. will extend water and sewer systems; will issue $120,000 bonds.

Ohio, Cleveland—City considering cast iron main from Kirkland Pumping Sta. to new Baldwin Reservoir at cost of $1,700,000. A. V. Ruggles, City Hall, Engr.

Ohio, Germantown—City planning to lay 65,000 ft. 4-12 in. mains and construct deep well system. $100,000. Jennings-Lawrence Co., Hartman Bldg., Columbus, Engrs.

Ohio, Salem—City considering constr. of rein. conc. reservoir, tank house, pipe lines. etc. Est. cost $500,000. M. Knowles, Jones Law Bldg., Pittsburgh, Pa., Engr.

Ohio, Wellsville—Prelim. plans being made for 3½ miles of pipe lines, filtr. plant, 2,500,000-gal. capy., and new dam. $300,000. Morris Knowles, Inc., 1004 Hanna Bldg., Cleveland, Engrs.

Ore., Portland—Bd. Water Commrs., Corvallis, by E. L. Strange, Supt., has applied to State Engr., Percy A. Cupper, for permission to construct reservoir on Rock Creek, tributary to St. Mary's river, to store 535 acre ft. of water. This is part of proj. to enlarge present water system at cost of $100,000.

Okla., Apperson—It is planned to install electric pumps and construct water works.

S. C., Winston-Salem—$200,000 may be expended here for installing water and sewer systems in South side. H. L. Shaner, Commr. Public Works.

S. D., Rapid City—Prelim. plans made for impvt. of water works. Burns & McDonnell, 402 Inter State Bldg., Kansas City, Mo. Jno. J. Hays, Supt. of Water Works.

Tenn., Knoxville—N. E. Logan will install water mains in 175 acres of Kingston Pike Development.

Tenn., Memphis—Fuller & McClintock, Cons. Engrs., New York City, retained by City to prepare plans for artesion water works system. Est. cost $2,000,000.

Tex., Baird—$60,000 bonds voted for impvt. of water works, including conc. reservoir and enlargement of mains.

Tex., Cameron—Cameron Water, Power & Light Co. will improve plant; increase capy.; install additional treating plant at cost of $40,000.

Tex., Childress—City considering constr. of lake and reservoir; plans voting on $300,000 bonds. R. G. Carraway, Engrs.

Tex., Highland Park, (P. O. Dallas)—City will purchase and extend Highland Park water works. $150,000 bonds voted. H. R. Davis, Mayor.

Tex., Stephenville—$50,000 voted for water works impvts. here.

Va., Ashland—Town contemplates expendt. of $70,000 to extend water and sewer systems.

Va., Danville—Town Council considering issuance of bonds to improve streets and increase water supply. $20,000 wil be used to erect filter plant and bring additional supply of water from a mile or more beyond town.

Va., Harrisonburg—City will construct additional supply reservoir at cost of $40,000. Extend 20-in. pipe line from source of city's water supply 15 miles west of town to new reservoir at cost of $115,000.

Va., Pennington—Pennington Water Co., (Walter R. Pennington) plans expendt. of $40,000 to $46,000 on water works plant, install gravity flow line, daily capy. 300,000 gals. reservoir with capy. of 100,000 gals. E. E. Thompson, Engr.

W. Va., Grafton—Citizens in favor of bond issue for water works impvts. Pure Water League (composed of women) strongly in favor of purifying water supply.

W. Va., Rivesville—City plans expendt. of $40,000 to install water works; 40,000 gals. daily capy.; install centrif. pumps, omtors, etc., construct 50,000-gal. wood reservoir. B. Kress, Engr., Elkins, W. Co.

Wis., Milwaukee—City Engr. and Cons. Engr. of West Allis also Acting City Engr. of Milwaukee will determine location for a 24-in. main to increase water pressure in West Allis and whether standpipe or reservoir should be built in the suburb to increase the pressure in the higher districts. H. P. Bohmann, Supt. Milwaukee Water Dept.

Wis., Prairie du Sac—City will soon take bids on 100 water meters. J. B. Ragatz, Clk.

Wis., Tomahawk—Revising plans for reservoir. Owner—Wisc. Valley Impvt. Co., (Walter Alexander, 320 McIndoe St., Wausau). W. E. Brooks, Engr., 1st Natl. Bank Bldg., Wausau. Est. cost $100,000.

BUYERS' GUIDE

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Midwest Engine Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Midwest Engine Co.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Soaps—Liquid.
Integrity Chemical Co.

Special Castings.
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch
The Barrett Co.

Tar Heaters.
Littleford Brothers.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Nutting Co., H. C.
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Traffic Signals.
Electrical & Specialty Supply Co.

Trailers.
Lee Trailer and Body Co.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Turbines, Steam.
De Laval Steam Turbine Co.

Valves.
Coldwell-Wilcox Co.
The Flower Company.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barber Asphalt Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
The Flower Company.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

INDEX TO ADVERTISEMENTS

Alvord, Burdick & Howson, Chicago, Ill... 157
American Appraisal Co., Milwaukee, Wis... 157
American Steel & Wire Co., Chicago, Ill.... 12
American Telephone & Telegraph Co., New York, N. Y.....
American District Steam Co., North Tonawanda, N. Y. 149
Artingstall, Wm., Chicago, Ill..... 157
Asphalt Association, The, New York, N. Y. 14
Austin-Western Road Machinery Co., Chicago, Ill. 12
Austin Machinery Corporation, Chicago, Ill. .....Back Cover

Barrett Co., The, New York, N. Y..... 139
Brossman, Chas., Indianapolis, Ind..... 157
Buffalo-Springfield Roller Co., Springfield, O. 8
Burch Plow Works Co., Crestline, Ohio.... 16
Burd & Giffels, Grand Rapids, Mich..... 157
Buyers' Guide 35, 37, 39

Cannelton Sewer Pipe Co., Cannelton, Ind.. 155
Carey Co., The Philip, Cincinnati, O..... 11
Chicago Paving Laboratory, Chicago, Ill... 157
City Wastes Disposal Co., New York, N. Y.. 157
Coldwell-Wilcox Co., Newburgh, N. Y..... 159
Cummer & Son Co., The F. D., Cleveland, Ohio 16

Dee Clay Mfg. Co., W. E., Chicago, Ill..... 16
Dee, Wm. E., Chicago, Ill..... 158
De Laval Steam Turbine Co., Trenton, N. J.
Direct Oxidation Process Corp., Philadelphia, Pa. .....
Dow & Smith, New York, N. Y..... 157
DuPont DeNemours & Co., E. I., Wilmington, Del. 5

Electrical & Specialty Supply Co., Chicago, Ill. 21
Engineers and Contractors 157, 158

Fargo Engineering Co., Jackson, Mich..... 157
Federal Motor Truck Co., Detroit, Mich....
Flood, Walter H., Chicago, Ill..... 157
Flower Co., Detroit, Mich..... 158

Harris Air Pump Co., Indianapolis, Ind...
Heltzel Steel Form & Iron Co., Warren, Ohio 6
Hill & Ferguson, New York, N. Y..... 157
Holt Mfg. Co., Inc., The, Peoria, Ill..... 10
Howard, J. W., New York, N. Y..... 157
Hunt, Robert W. & Co., Chicago, Ill..... 157

International Motor Co., New York, N. Y...

Jones, Sam L., Cincinnati, Ohio..... 158
Jordan & Steele Mfg. Co., Inc., Charlotte, Mich. 8

Kalamazoo Foundry and Machine Co., Kalamazoo, Mich. 30
Kentucky Rock Asphalt Co., Louisville, Ky.. 24
Kirchoffer, W. G., Madison, Wis..... 158
Kissel Motor Car Co., Hartford, Wis.....
Koehring Co., Milwaukee, Wis..... 9
Kolesch & Co., New York, N. Y..... 31

Lewis-Hall Motors Corp., Detroit, Mich.... .....Front Cover
Littleford Bros., Cincinnati, Ohio..... 13
Lufkin Rule Co., The, Saginaw, Mich..... 31

Mac Rae's Blue Book Co., Chicago, Ill..... 4
Madison Foundry Co., Cleveland, Ohio.... 151
Metropolitan Paving Brick Co., Canton, O..
Morse, Wm. F., Cleveland, Ohio..... 158
Motor Truck Section.....17, 24
Murphysboro Paving Brick Co., Murphysboro, Ill. 30

National Paving Brick Mfrs. Assn., Cleveland, Ohio 10
Newport Culvert Co., Inc., Newport, Ky.... 14
Nutting Co., H. C., Cincinnati, Ohio..... 158

Olsen Testing Machine Co., Philadelphia, Pa. 155

Packard Motor Car Co., Detroit, Mich..... 19
Pawling & Harnischfeger Co., Milwaukee, Wis. 15
Pennsylvania Salt Mfg. Co., Philadelphia, Pa. 158
Phoenix Mfg. Co., Eau Claire, Wis.....
Pierce-Arrow Motor Car Co., Buffalo, N. Y. 14
Pioneer Asphalt Co., Lawrenceville, Ill..... 12
Portable Machinery Co., Inc., Passaic, N. J.
Portland Cement Association, Chicago, Ill.. 2
Potter, Alexander, New York, N. Y..... 158

Republic Creosoting Co., Indianapolis, Ind.. 16
Rosing, Inc., Astrid S., Chicago, Ill..... 158

Sauerman Bros., Chicago, Ill..... 30
Smith Co., The, T. L., Milwaukee, Wis.....
Springfield Paving Brick Co., Springfield, Ill. 16
Standard Oil Co. (Indiana), Chicago, Ill... .....Inside back cover
Stewart, W. H., St. Louis, Mo..... 151
Strickler, W. W., & Bros., Columbus, Ohio. 151
Sullivan, Long & Hagerty, Bessemer, Ala.. 158

Texas Co., Asphalt Sales Dept., New York, N. Y. 7
Truscon Steel Co., Youngstown, Ohio..... .....Inside front cover

United States Cast Iron Pipe & Foundry Co., Burlington, N. J. 151

Van Trump, Isaac, Chicago, Ill..... 158

Warren Brothers Co., Boston, Mass..... 1
Webster Mfg. Co., The, Chicago, Ill.....
Wells, James P., Rochester, N. Y..... 158

Warrenite-Bitulithic

in Dallas, Texas, after four and one-half years' use.

"*Subject:* Rusurfacing Macadam Streets—
Warrenite-Bitulithic Pavement.

Dallas, Texas, Feb. 27, 1922.

To Whom it May Concern:

The city of Dallas has resurfaced several macadam streets with 2-inch surface of Warrenite-Bitulithic Pavement. The oldest of these streets has now been down about 4½ years.

This type of pavement has proven absolutely satisfactory, and no one need hesitate to construct pavement in this manner.

Yours truly,
G. D. FAIRTRACE,
City Engineer."

GDF/HT

What **Warrenite-Bitulithic** has done for Dallas, Texas, it will do for your city. We will gladly give you the benefit of our expert opinion in the street paving industry, backed up by fifty years' experience. Let us assist you in formulating your plans for street construction.

For information, communicate with our nearest office.

Warren Brothers Company

Executive Offices: BOSTON, MASS.

DISTRICT OFFICES:

Utica, N. Y.	New Orleans, La.	Toronto, Ont.	Washington, D. C.
Portland, Ore.	Chicago, Ill.	Winnipeg, Man.	Minneapolis, Minn.
New York, N. Y.	St. Louis, Mo.	Memphis, Tenn.	San Francisco, Cal.
Vancouver, B. C.	Phoenix, Ariz.	Los Angeles, Cal.	

USE
CONCRETE
FOR PERMANENCE

A Street Has a Hard Job Now

Carrying the light, horse-drawn traffic of a few years ago was one thing. Carrying the swiftly moving automobiles and pounding motor trucks of today is quite another.

How much of the trouble with street pavement in your town comes from not recognizing the difference?

Just as faster and heavier railway trains compelled heavy, modern rails and roadbed, so the heavy pounding traffic of today calls for rigid Concrete streets.

Experience shows that Concrete pavement can be built to stand any kind of traffic, indefinitely, practically without repairs.

Easy riding, skid-proof, hole-proof, permanent—that is Concrete.

Our Booklet R-4 tells other interesting things about Concrete streets. Write for your copy.

PORTLAND CEMENT ASSOCIATION

A National Organization to Improve and Extend the Uses of Concrete

Atlanta	Des Moines		Parkersburg	San Francisco
Boston	Detroit	Los Angeles	Philadelphia	Seattle
Chicago	Helena	Milwaukee	Pittsburgh	St. Louis
Dallas	Indianapolis	Minneapolis	Portland, Oreg.	Vancouver, B. C.
Denver	Kansas City	New York	Salt Lake City	Washington, D. C.